ESSAY

ON THE

MINERAL WATERS

OF

CARLSBAD.

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To

the Royal Medical

Society of Edinburgh

with the Author's

respects

Fairbad, 19th August 1835.

ESSAY

ON THE

MINERAL WATERS

OF

CARLSBAD.

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ESSAY

ON THE

MINERAL WATERS

OF

CARLSBAD,

FOR

PHYSICIANS AND PATIENTS,

BY

CHEVALIER JOHN DE CARRO,

M. D. of the Faculties of Edinburgh, Vienna and Prague,
and physician at Carlsbad during the season.

WITH

OBSERVATIONS

ON THE

MICROSCOPIC ANIMALCULES ABOUT THE HOT SPRINGS OF CARLSBAD,

BY

MR. A. J. C. CORDA, OF PRAGUE,

AND A

FLORA OF CARLSBAD,

BY

PROFESSOR C. B. PRESL, OF PRAGUE.

PRAGUE, 1835.

PREFACE.

When I left Vienna, after thirty-three years practice, in the spring of 1826, to recover at Carlsbad my health totally impaired by gouty affections, and to pursue there my medical career, the english visitors scarcely amounted to twenty, and the greater part of those came not directly from England, but were sent by continental physicians, whom they had consulted in the course of their travels. A great change has since taken place. Excellent roads, quicker stage-coaches, steam-boats, better accommodations, useful improvements in the town itself, successful treatments, have increased the

fame of our hot springs, upon which, since 1521, innumerable latin and german books have been published, some of them by physicians of universal renown, such as Frederick Hoffmann and Tralles in the eighteenth century, Hufeland and Kreysig in the nineteenth. Impressed with the utility of giving an account of the nature and effects of these waters, in a language universally understood among the higher orders of society and learned men of all nations, I published in French: *Carlsbad, ses eaux minérales et ses nouveaux bains à vapeurs.* Carlsbad, 1827; with an *Appendix* since 1829; and later, the *Almanach de Carlsbad, ou Mélanges médicaux, scientifiques et littéraires, relatifs à ces thermes et au pays.* Prague, 1831, 1832, 1833, 1834, 1835. Though the booksellers, who have the copy-right, take no trouble whatever to sell them beyond the place, the good effect of these publications, bought by english visitors, and occasionally read in England by physicians and invalids, has been, conjointly

with the above enumerated causes, so manifest, that the *List of strangers,* published during the last season, presents the names of 153 british ladies and gentlemen, amongst whom are to be found their Royal Highnesses the duke and duchess of Cambridge, an ambassador, an envoy extraordinary, six lords, four baronets, a field-officer, a consul, an ex-lord mayor of London, a gentleman of His Majesty's privy-chamber, two doctors of medecine, a surgeon, two clergymen and several military and naval officers, most of them with their families.

The establishment at Brighton, where the various german mineral springs, and also those of Carlsbad, are imitated by a chemical process, has drawn the attention of the public more towards them than the best publications. The patients, who came over to us, after having drunk *Carlsbad* at Brighton, held all the same language. Those who thought themselves benefited by the imitation, said: "We come "to you to accomplish our cure;" and

those whom Brighton had not restored, regretted their having placed confidence in artificial preparations. Far from attempting to depreciate those imitations, or examining in what respects art and nature may agree or differ, my sole object is to point out the causes of the increase of english visitors at Carlsbad. Knowing that hepatic, splenetic, dyspeptic, gravelly, herpetic and gouty cases abound in Great Britain, as indeed more or less every where, many of those invalids have encouraged me to publish an english description of the place, and a short account of the nature and effects of our waters, and of the various ways of using them, either by drinking, bathing or steam. It will be perhaps considered as a bold undertaking, to write in a language which I learned nearly half a century ago, during my medical studies at Edinburgh. My only wish is to be understood, and I shall never take it amiss, if my reader now and then smiles at a gallicism or a germanism.

As far as I know, the english medical litterature has no other writings to produce upon Carlsbad, but

1. A *Letter of James Mounsey, M. D., Physician to the Czarina's army, to Mr. Baker, F. R. S., on the hot springs of Carlsbad.* Riga, 1 July 1749. Philos. Trans. vol. 46. p. 217.
2. J. Milles, *Relatio de aquis mineralibus Carolinis in Bohemiâ.* Ibid. vol. 50. P. 1. p. 25.
3. *Robert Whytt's works.* Edinb. 1768. 4.
4. A translation of Dr. Kreysig's (of Dresden) german work, under the title of *Treatise on the use of the natural and artificial waters of Carlsbad, Ems, Marienbad,* etc. London, 1824. *Sold at Brighton.*

Though the nature of our springs has not been altered, since the three english physicians, just mentioned, wrote upon them, medical and chemical doctrines have undergone as many changes as the place itself and its institutions. Such

writings, beside, inserted in scientific collections, are known but to some learned physicians, and treat only of a few questions concerning our waters. As to Dr. Kreysig's work, the greatest praise is due to Dr. Gordon Thompson and Mr. F. W. Bekenn, whose translation is far more lucid and intelligible than the theoretical part of the original. Much, but not the same, can be said on *natural* and on *artificial* mineral waters, and the medical world has not yet understood how such a celebrated physician as Dr. Kreysig, could so completely assimilate art and nature, both in the text and title of his work.

PRAGUE, 12th January 1835.

CARLSBAD.

FIVE and twenty years before Wenzel Payer, of Ellbogen (1), wrote the first medical treatise on the hot springs of Carlsbad, a bohemian nobleman, Bohuslas de Lobkowitz (2), sung their virtues in the following hexameters:

IN THERMAS CAROLI IV.

Fons, Heliconiadum merito celebrande cohorti,
Unde tibi latices calidi, venaeve meantis
Sulphuris, aut vivae, dictu mirabile, calcis?
Per terras Siculamne ignis qui provocat Aetnam,
Id facit? An Stygii forsan vicinia Ditis
Has tepefecit aquas? Baïarum littora cedant,
Atque Antenoreum prospectans unda Timavum,
Et quae caeruleo consurgit proxima Rheno,
Nobilitata tuo, sanctissime Carole regum,
Interitu. Quantas emittit in aëra bullas!
Aspice quam variè lapides et marmora pingit
Per quaecunque fluit! Vix ipsa coloribus Iris
Collucet totidem! Felix per secula mana,
Fons sacer, humano generique salutifer esto!
Redde seni validas vires, pavidaeque puellae
Formosam confer faciem, morbisque medere
Omnibus, et patrias accedat laetior oras
Quisquis in hâc lymphâ fragiles immerserit artus!

The classical beauty of these lines induced me, in the year 1828, to have them ingraved in golden letters upon black marble, and placed upon one of our bath-houses (the Mühlbrunn). In order to illustrate that simple and honourable monument, erected at public expenses, I published the Life of the poet, a commentary and numerous translations of the Ode, under the title: *Ode latine sur Carlsbad, composée, vers la fin du quinzième siècle, par le baron Bohuslas Hassenstein* (3) *de Lobkowitz, avec une polyglotte, une notice biographique sur ce poète, des observations sur l'Ode, et sur l'antiquité de ces thermes.* Prague, 1829.

Those versions increasing annually, their collection has acquired some philological worth, and interested the innumerable scholars of all nations, who render Carlsbad a living polyglot. For the present work I shall only select an english version, written last year by a Noble Peer, whose poetical talent was animated by his high opinion of the salutary effects of our springs; a gaelic one, particularly admired by several good judges of Ossian's tongue, and a turkish one, composed by a student (since 1835 doctor) of medecine, son of a citizen of Carlsbad, a real *αυτοδιδακτος*, whose two versions (I publish only one here) have deserved the full approbation and admiration of the first orientalist of the Austrian dominions (4).

ON THE HOT SPRINGS OF CHARLES IV.

Fountain of health, the poets honoured theme,
Say whence thy fervid waters flow!
Rush they in subterraneous stream
From where sulphureous tides in Aetna glow,
Or fraught with healing elements ascend,
Sent, when the Stygian God in softened mind,
Had bid his fires their genial influences lend,
In mercy to mankind?

To thee the palm must classic Baïae yield
And Brentus baths by old Antenor sought,
And e'en the Rhenish springs, historic field,
Where Charlemagne victorious fought,
And where they wept him dead,
To thee must bow the head.
See how the bubbling water steam on high,
Impatient of restraint,
The rock, the marble, owns a brighter dye
Than Iris itself could paint!

To suffering man from nature's genial breast
A boon transcendant ever may'st thou flow,
Blest holy fount, still bid old age to know
Reviving vigour, and if health repressed
Fade in the virgins cheek, renew its glow
For love and joy, and they that in thy wave
Confiding trust and thankful lave
Propitious aid, and speed the stranger band,
With health and life renewed to the native land.

Carlsbad, 16th September 1834.

ALVANLEY.

GAELIC VERSION.

AIR TOBAR THEARLAICH IV.

'S airidh do cliu, Thobair ghrinn
Air co' sheirm na'n cliar-oigh'n binn.
Co as tha na mear-ghlugain bhlàth,
Roimh t-fheithan caochanach tha snamh?
Thair cladach's beophronasc a'ruith,
Co as tha iad sin teachd a muigh?
'Ne Etna na Ifrin, le'n teas,
Tha cuir t-uisg'air ghoil mar eas?
Bi Bäia neo-mhuirneach a chaoidh;
'Sgad thug cliu Thimabhais fein
Antenor chuige mar aoidh,
Sguirar bhi tuille ga'n seinn;
'Stheid am feasda gu di-chuimne.
Fuarain ghorma srath na Ruinn
Dha t ainmsa struchdaidh iad guleir,
Ainm Rhigh Tearlach na'n deagh bluagh
Tha Thusa cho ùrd os an-ceann
S'tha esan os ceann gach sluaigh.
Feuch an coileach buirn mar ghath,
'Stealladh's na speuran le sraon!
'S an cladach shios air mhille dath,
Dh' fhagas fann am bogh-braoin!
Siorruidh mear bi'dh do shrù' caoin,
Jocshlaint' naomh do n'chinne-dhaoine!
Thoir neart do aois; 's do n'mhaid in thinn
Thoir gruaigh mar ròs is ceol-ghuth binn,
'S gachneach a nigheas ann do thònn
Cuir dhachaidh meaghrach slan le fonn.

DONALD MAC PHERSON.

TURKISH VERSION.

PÂDICHÂH CAROLOS ILIDJÉSI UZÉRINÉ.

Tchechmésâr chu 'arâ itchré mechhour,
Abi guiermun né yerden îtdi soudour,
Di né yerden quizar quibriti révân,
Yâ bou emvâdji sâroudji souzân?
Asli mi quiouki Etna-i 'azim,
Dibdé mi yanayur nâri hadjim?
Bayanin yalisi viré sana yer,
Vé Timavosé âb iden nézer,
Vé yaquin mâvi Riné tchechmésâr,
Candé Châh Carolos bouldi mézar:
Né cader quieupurur caynac guirdâh,
Yucséguié né cader satchar habâb!
Bac né guioun senkler éyléyur i 'lâm,
Guiudjlé bou nour virur quiémâni bénâm.
Her zéman devlet ilé ol djéréyân,
Sendé boulsun chifâ nev 'i insân,
Djumlé zahmetlérè dévâ éylé.
Piré couvvéti ten 'atâ eylé.
Bécri tersnâquié éylé ghil imdâd,
Vedjhi mânendi guiul ola dilchâd:
Her quichi cház idé vatané rudjou',
Qui 'ilâdj soulérunden itdi toulou.

AUGUSTUS PFITZMAYER.

According to an old tradition, supported by no historical records, the hot springs of Carlsbad were first discovered, about the middle of the fourteenth century, by Charles IV, emperor of Germany and king

of Bohemia. One of his hounds, when following a stag, having fallen into the boiling water, gave by his howling such indication of pain, as to cause the monarch and his retinue to approach the wells, where they saw with amazement the wonderful and high springing Sprudel, which no one, even to this day, can contemplate without admiration. The emperor, labouring under an infirmity in his leg, his physicians recommanded him to bathe in this spring; he built a castle near the hot waters, encouraged the neighbouring peasantry to settle there, and named his new town *Carlsbad* (Charles 's bath).

A document, of a rather questionable nature, had grounded the belief that Charles IV had used our baths in November 1347, whilst residing at Ellbogen, for the healing of wounds received at Crécy, on the 26th August 1346, where he lost his father, the blind king John, under Philip VI of France, against Edward III of England. New researches (*Almanach de Carlsbad*, for 1835, ch. IX.) have however demonstrated, without controversy, that Charles was not in Bohemia from the beginning of October 1347 to the 19th February 1348. That he ever bathed in our hot springs is uncertain, not one word being said about it in his *Life*, written by himself, nor by any of his historians, who followed almost every step of that beloved sovereign. That he granted important privileges to Carlsbad, dated from Nuremberg 14th August 1370; that he gave his name to the town, and that he resided there in 1370 and 1376, are the only

historical facts we can quote. The foundation of the University of Prague, in 1348 (the oldest in Europe after those of Paris and Bologna), by Charles IV; the nomination of a great number of celebrated foreign and national professors, spread so much scientific knowledge in Bohemia, that it is probable enough that our hot springs, only known as a wonderful natural phenomenon, attracted then the attention of learned physicians, who gradually extended the fame of their medical virtues.

Before a mineral spring acquires renown, it is in general known in its neighbourhood alone, till successful cases attract the attention of physicians and of the owners of the soil, who then form establishments for the accommodation of visitors. Such was very likely the fate of Carlsbad, called formerly and still now, by the neighbouring peasants: *Warmbad.* Ellbogen, one of the oldest fortresses of Bohemia, five english miles distant from Carlsbad, was, long before that time, inhabited by kings and grandees, to whom the astonishing phenomenon of the bubbling springs and their thick vapours could no more remain unknown, in a valley open at both ends, than to woodsmen, sheperds, fishers and sportsmen. How could the most ignorant boor not be struck with such a scenery? How could he not notice that the river, lower than the wells, never freezes; that snow never stays on the ground about the thermal chaldron? In short, how could so many uncommon things remain unobserved by the neighbouring population? The

existence of a castle is proved by indisputable documents (*Almanach de Carlsbad,* 1832, ch. XXI.), and though no farther vestige of a building is now to be seen, the names of a street (*Schlossberg*, Castle-Hill) and of a fountain on the top of that hill (*Schlossbrunn*, Castle-Wells) attest sufficiently the former existence of a castle.

Historical details about the successive improvements of Carlsbad, the calamities it has suffered by war, inundations and fire, the progress of its institutions, the privileges granted to its citizens by several sovereigns, the list of its numerous benefactors, not belonging to a sketch like this, we shall speak of the place and of its establishments, not such as they have been, but such as they are. Much has been done, in every respect, by Government and the inhabitants, since the beginning of this century.

The town, without its territory, counts above 500 houses, in general clean and comfortable; the proprietors keep for themselves the ground-floor, and let the other rooms with furniture, table and bed-linen. The population in winter is about 3000 catholic inhabitants, all germans, and is considerably augmented, during the season, by female servants, waiters and tradespeople of all descriptions, coming from every part of the country, to minister to the wants of so many visitors, the gradual increase of whom is seen by the authentic Lists, regularly published, shewing for

. the year 1785: 445 families.
„ 1795: 634
„ 1805: 725
„ 1815: 1302
„ 1825: 1660
„ 1834: 3287 or 6165 persons.

Travellers passing through Carlsbad are not inscribed in the *Visitors List*, and those who do not remain above five days, have no tax to pay. That tax *(Cur-Tax)* is four florins silver a head; children under fifteen years, as well as domestics, are free from it; children above fifteen, coming with their parents, pay the half-tax. That revenue is entirely devoted to useful establishments and embellishments.

Carlsbad, sixty german miles distant from Vienna, and sixteen from Prague, is situated in a deep and narrow valley, between granitic rocks, on both sides of the Teple, which throws itself into a larger river, the Egra, very near the town. The houses are all built on the declivity of the hills, and on the banks of the Teple. Those hills, beautifully wooded, offer innumerable and well kept walks, the greatest variety of prospects, and an interesting field to lovers of geology and botany.

According to the last observations of the Rev. A. David, royal astronomer at Prague, Carlsbad lays 50° 13′ 38″ of latit., 30° 32′ 47″ long., and 182 fathoms above the level of the sea near Hamburgh.

*

Invalids coming from Prague were formerly obliged to descend the mountain, at the foot of which the town and its springs lay, by roads fiter for goats and woodsmen, than for heavy carriages. During one of the most calamitous periods of his reign, from 1804 to 1806, the late emperor had a magnificent serpentine *Chaussée* constructed, at the expenses of 160,000 silver florins, by which the town is approached with so much ease, and offering so delightful a prospect, that visitors have been known to say, the pleasant sensation this causes was sufficient alone to come here. For lighter carriages, a shorter cut of a road, called the *Tappenhof-Chaussée,* leads more directly down the hill, and is far easier than the *Prague street* (Prager Gasse). From the Egra side the roads, formerly very bad, are now excellent and flat. A statement of what has been done for the improvement of roads in all directions, in order to establish better and shorter communications between the different watering-places of Bohemia, and for the improvement of Carlsbad, only since the beginning of the present Grand-Bourgrave (governor of the kingdom) count Charles Chotek's administration, viz. since 1827, is to be seen in my *Almanach* for 1833, ch. XII and XIII. The great improvements of roads have facilitated the establishment of *Stage* and *Mail-coaches,* under the name of *Eilwägen* (vélocifères). For those who, by motives of health, are obliged to travel slowly (à petites journées), veturinis *(Landkutscher)* are every where to be had. From Prague

to Carlsbad, for instance, the *Eilwagen* requires fourteen hours, whilst a *Landkutsche*, with the same horses and loaded with baggage, requires two days.

According to an old custom, sometimes annoying to sick people, lodged on the *Market-Place*, but pleasing to those who enjoy the daily increase of visitors, watchmen, posted upon the Tower-gallery, salute with trompets, more or less numerous, according to the size and elegance of the equipage, the new comers, upon whom they wait the next day, for a remuneration, entirely left to the good will of the visitor, who has, for the next evening, another tribute to prepare for a regular *sérénade*, given under his windows by performers not unworthy of the philharmonic renown of Bohemia.

During the whole season, the names, quality and domicile of visitors are inscribed in a List *(Cur-List)*, published almost daily, for the price of fl. 1. 24 kr. silver, and 12 kr. for the insertion of the name.

Strangers, accustomed to their own wine, can import, free of duty, one *Eimer* or eighty bottles of any foreign wine. One pound of tobacco is equally allowed to each visitor.

Since 1830, an elegant reading-room for german, french and english news-papers, has been opened for the moderate price of 40 creutzers a week.

During the season there are two booksellers at Carlsbad. Pianos and guitars can be hired; a theater, concerts, balls and other amusements are not wanting; but walking, riding and driving, offer to visitors

the greatest variety of resources. The company, being composed of people of all ranks, of all nations, religions and professions, every one chooses what is more analogous to himself, rather than to seek equality, as impracticable at Carlsbad as any where else. It is out of the plan of this compendium to describe the numerous places which offer agreable excursions. Those who do not bring their own horses and carriages, find here caleches, few saddle-horses, and donkeys. Carlsbad, being nothing more than a most elegant hospital, is by no means a place of dissipation. The amusements are of a quiet and moderate kind; the necessary early hours for attending the wells in the morning prevent late ones at night; the strict prohibition of hazard-games; the obligation of submitting to a sober diet, and of taking much bodily exercise, have introduced very regular habits into society, and more than one gastronome and hard drinker has began at Carlsbad to understand the incalculable advantages of sobriety and temperance.

We have already mentioned the external and internal cleanliness of the houses, some of which are very small, others large enough for the accommodation of numerous families. The most elegant are on the *Wiese* and on the *Market-Place*, and more expensive than those situated in the higher and more remote streets. In most houses the beds are good, at least as good as in any part of Germany, though many tall visitors wish them longer, and the coverlids broader. The price of lodgings varies with their

situation and the season, which begins with the 1st May and lasts to the end of September. It is not rare, however, to see patients at Carlsbad in April and October (5). The most crowded period is from the 15th of June to the 15th of August, and, of course, the price of lodgings then much higher than during the first part, and particularly than during the later part of the season, when proprietors, having nothing more to hope, take lodgers almost at any price. That price is always fixed weekly. Large families will act prudently in securing their lodgings before their arrival, and can apply, for that purpose, to the physician to whom they are recommanded; in which case it is indispensable to fix with precision the day of the arrival, the length of the stay, the number of rooms and beds, servants, horses, etc. Those who have not taken such precautions, will find in general temporary accommodations at the principal inns, such as the *Golden Schield*, the *Golden Lion* and the *Paradise*.

As to living, visitors coming without their own cook, find numerous eating-houses and *restaurans*, where they can go to or send for their dinner. These houses are frequented by ladies as well as gentlemen. The *Salle de Saxe*, the *Posthof* and the *Freundschafts-Saal*, where the dinner is at so much a head (in general one florin silver), are frequented by the best company; but those who prefer to choose their dishes, dine *à la carte*, and equally well, at the *Golden Schield*, the *Bohemian Salle*, the *Stadt Paris*,

the *Three Pheasants*, the *Lusthaus*, etc. etc. The *Blue Pike* (Blaue Hecht) on the *Wiese* sends dinners any where, but does not receive company. The coockery is plain and alike every where, and no invalid has reason to fear the temptation of dishes contrary to the laws of the cure, about which all inn-keepers have traditional and almost invariable principles, suggested by the medical Faculty. Besides, regimen and diet are always a subject of advice at the first interview between the physician and the patient.

Of the articles of diet allowed, beef and mutton are of good quality; veal, chicken and pidgeons are very seldom properly fed; venison (deer) and ducks are always to be had; partridges, pheasants and hares in their season; porc and goose are forbidden; vegetables are neither plentiful nor cheap, and not all salutary. Carp, pike and trouts are in general to be had, but particularly on fast-days, and all that class of farinaceous compounds, called *Mehlspeisen*, are perfectly well understood at Carlsbad. Made dishes and scientific ragouts are never to be met with, except when particularly ordered. Salad and raw fruit are not allowed. Breakfast will be treated of later.

Living, in general, is cheap, for those who are under the obligation of oeconomy, though innumerable occasions offer daily of spending money, as every where else. A very tolerable dinner, *à la carte*, of three or four dishes, with a bottle of good beer, can be had for half a florin (30 creutzers). For the sake

of those innumerable invalids, who weigh and calculate what they eat, and even for those who like several dishes, but little of each, half-portions are to be had in many eating-houses.

The citizens of Carlsbad are in general civil and obliging, and strangers, travelling without servants, find in every house the necessary attendance. They are industrious; all sorts of workmen and tradespeople are found amongst them, and they have even acquired some renown in the fabrication of fire-arms, cabinet-work, cutlery and pins; the incrustations produced by the fixed parts of the waters, called *Sprudel-stones,* are an object of industry. A number of tradesmen of all sorts come, during the season, from Prague and Vienna; bohemian glasses, hyaliths, the pewter-ware of Schlaggenwald, fill very beautiful shops, and all the china and fine potter's-ware manufactures of the kingdom are near Carlsbad.

The china or earthen cups, used by the water-drinkers, vary in beauty and price, but are of the same size, viz., about six ounces. Dials, with moveable hands, assist the memory of those who drink a great number of goblets.

Carlsbad has its magistracy, presided by a burgomaster; but, during the season, the Government of Prague delegates a commissary for the Inspection of the place, to whom strangers must apply about passports, in any contest that may arise between them and the inhabitants, in short, in every case where the assistance and decision of justice are requested.

Religious tolerance being complete in the Austrian dominions, I shall remark, for the tranquillity of those who might not be aware of it, that a part of the catholic church-yard is devoted to protestants, who are buried openly, and allowed to have their own funeral service performed by a clergyman of their confession, if they wish it, and if there happens to be one at Carlsbad, among the visitors. Many tomb-stones have been erected in that part of the church-yard, by non-catholics, to their deceased friends.

NOTES.

(1) *Wenzel (Venceslas) Payer or Bayer, of Ellbogen, born in the year 1488, studied at Leipsic, and took his degrees in 1507. Highly protected by the counts Schlick, to whom the greatest part of the royal domain of Ellbogen, and even Carlsbad, was mortgaged for the money they often lent to the kings of Bohemia, those rich and mighty noblemen sent Payer to Italy at their own expense. Inflammed by the sight of the remains of ancient baths and of some modern bathing establishments, he paid, on his return home, a particular attention to the hot springs of Carlsbad, where he first recommanded their internal use and the* douche, *so much employed then in Italy. The title of his work is:* Wenceslai Payer de Cubitu Tractatus de Thermis Caroli IV Imperatoris prope Ellbogen sitis. *Lipsiae, 1521; 2. edition, 1614. He died on the 11th December 1526, thirty-eight years of age. The mode of his death is uncertain; but he died gloriously, as proved by two silver medals, coined by order of the counts Schlick, proprietors of the celebrated silver mines and of the mint of Joachimsthal, near Carlsbad, with Payer's effigy and the honourable inscription:* Cum pariter omnibus moriendum, non tardè sed clarè mori optandum. *Those medals are at Vienna in the imperial numismatic Museum. Payer being represented as Curtius, precipitating himself into an abyss, it is highly probable that he died victim of his scientific*

zeal in investigating the Sprudel. I have described and commented these medals in my work: Carlsbad, ses eaux minérales, *etc. p. 205.*

(2) *Lobkowitz, an illustrious bohemian nobleman, born in the year 1462, died in 1510; he was one of the most learned men of his age, an admirable latin poet, a great traveller, a distinguished statesman, and promoted mightily the restauration of the ancient classical litterature in Germany. He studied at Bologna and Ferrara, and visited afterwards several german universities, particularly Strasbourg, then imperial. In 1490, he embarked at Venice, visited the Ionian Islands, Candia, Cyprus, Rhodes, the Dardanells, Constantinople, Asia Minor, the soil where Troy was, Smyrna, the ruins of the Temple of Ephesus, went through Cilicia, Pamphilia, Syria, Arabia, and prayed over the cradle and the grave of our Saviour. He meant to go to India, but gave up that dangerous plan. He visited Egypt, its pyramids and cataracts, Alexandria, Cairo, the ruins of Carthago, and Tunis; crossing then the Adriatic, he landed at Venice in 1492. Lobkowitz, who gave an account of his travels in several latin letters, brought back a collection of the rarest and most precious objects, amongst others a manuscript of Plato, for which he paid 2000 Milanese ducats, existing still at Raudnitz, belonging to his family, the princes of Lobkowitz, dukes of Raudnitz. His library was the richest in Germany. His works were published sixty years after his death:* Illustris ac Generosi DD. Bohuslavi Hassenstein a Lobkowitz, Baronis Bohemici, poetae, oratorisque clarissimi Farrago Poematum in ordinem

digestorum per Thomam Mitem, Nymburgenum, Pragae, 1570. *His* Epigramma in Thermas Caroli IV *is p. 179. We possess also his* Epistolae *and his* Lucubrationes oratoriae. *His cotemporaries called him the* Ulysses, *the* Pliny, *the* Horace of Bohemia; *they might also have called him their* Juvenal, *for his satire on the nobility, gentry and people of his country, and for his very sharp letter on the morals of Prague. His works, formerly taught at Leipzic, among the roman classics, are now very rare; scarcely more than fifteen copies are extant in the principal public and private libraries of Bohemia and Austria. He is commonly called* The Great Bohemian *(Der grosse Böhme).*

(3) *A family seat, his Tusculum, where he was born, where he passed a great part of his life, and where he died, reduced now to venerable ruins, in the circle of Saaz.*

(4) *Augustus Pfitzmayer was born at Carlsbad, on the 16th March 1808, where his father, a native of Wirtemberg, keeps the* Posthof, *one of our best* Restaurans. *He received his first education at Carlsbad, but, when eleven years old, he was sent to Dresden (1819), to study under Mr. Philippi, director of a celebrated institution. Three years after he went to Pilsen (a small town in Bohemia), to attend his last philosophical classes. About that time he began to learn English, French and Italian, which he understands very well, and speaks as easily as can be expected from a young man, overloaded with other studies, and having few opportunities of conversation*

with foreigners. Of late he has made astonishing progress in the danish language. In 1827, he undertook the turk, without any teacher but Viguier's Grammar, and the various turkish books he found afterwards in the public libraries of Prague and Vienna. Having met with insurmountable difficulties of admission in the Oriental Academy *of Vienna, he tried jurisprudence; but seeing that neither the law nor the turkish language could lead him to any favourable result, he devoted himself to medecine, and took his degrees at Prague, on the 10th of March 1835. The best proof that he has not neglected oriental languages is the double turkish version of Lobkowitz's Ode on Carlsbad, which he gave me, in April 1831. Having asked him leave of submitting both to Mr. de Hammer's judgement, who himself, two years before, had declined to translate it at my request,* as too difficult, *the great orientalist of Vienna answered that „Pfitzmayer's versions were admirable; that I could „without any scruple print them in my* Polyglot, *etc.“ Augustus Pfitzmayer's beginning Life, his two versions and Mr. de Hammer's answers, are published in my* Almanach de Carlsbad, *1832, ch. XVIII.*

(5) *Peter I, czar of Russia, came twice to Carlsbad, towards the end of October 1711 and 1712, and the last elective king of Poland, Stanislas Poniatowski, drank our waters, during the winter of 1761, viz. three years before his election.*

THE WELLS.

All the hot springs of Carlsbad, rising from the same natural reservoir, issue from different orifices; each has its name and its temperature. Their number has often varied, some of them having appeared, disappeared and re-appeared. Others, on both sides of the river, are found in several houses, and might be, if necessary, adapted to medical use. We have now the *Sprudel*, the *Hygiaea*, the *Neubrunn*, the *Mühlbrunn*, the *Theresienbrunn*, the *Bernardsbrunn*, the *Schlossbrunn* and the *Spitalbrunn*.

The boiler, which supplies them all, formed by the mineral sediments of the water itself (the fragments of which are called *Sprudel-Stones*), has a depth, thickness, extent and ramifications, which no human eye can scrutinize, and the enormous clouds of hot vapours, escaping from every accidental or artificial opening, will probably baffle all attempts to ascertain the dimensions of that wonderful laboratory. Such trials were made in 1713 and 1727, after a

rupture of the boiler had taken place. The various boring and probing instruments penetrated through the calcareous crust, from one cavity to the other, till they reached at last an immense reservoir, the boundaries of which could not be attained by thirty fathoms length of poles, joined together, directed towards the *Market-Place* and the *Hirschensprung*. That a great part of the town stands upon these cavities, is sufficiently demonstrated, whenever the foundation of a new house is laid; copious streams of carbonic acid gaz are, moreover, incessantly seen bubbling in the river, near the wells.

Situated on the right bank of the Teple, in the centre of the town, the Sprudel, to which superior powers are attributed, is 60° R. or 168° F. It has various orifices, but two only are adapted to public use. One of them is exclusively called the *Sprudel;* the other, named *Hygiaeia,* on account of the statue of that goddess, placed near it, flows in a regular stream out of a pewter-pipe. Its vapour supplies our steam-baths. The broad square stones and long boards placed over the thermal chaldron, answer the purpose of a cuirass against the large masses of ice and floating trees, which, in their rapid course, when a thaw or an inundation takes place, might, like battering rams, break through the crust, and disturb the equilibrium indispensable to the regular spouting of the mineral water. In order to prevent such ruptures, whose cicatrisation is always slow, troublesome and expensive, the incrustation of its orifices is

removed four times a year by a boring apparatus. The Sprudel water boils eggs hard, and is employed, since time immemorial, to scalding poultry and pigs, and to other such purposes, which are more oeconomical than grateful to the eye. The difference of temperature between fountains, coming from the same reservoir, is generally accounted for by the various distances of their orifice from the great focus, and by the warmer or cooler soil upon which the water circulates in the impenetrable meanders of this aquatic volcano.

The springs of the *furious* fountain (as Frederick Hoffmann called the Sprudel), the truest emblem of perpetual motion, are in general explained in the following manner: The upper parts of the reservoir fill themselves with carbonic acid gaz, escaping the more freely from the hot fluid mass, as the pressure under which it lays, diminishes in proportion to the evaporation of the gaz. In that free state, the gaz accumulates in the upper part of the cavity; when considerably increased, it depresses the surface of the water, which rushes out of the same orifice; and these two elements, under the form of vapour, escape together, giving in a minute, without intermission, eighteen or twenty ebullitions, from four to eight feet high. A hollow, unequal and subterraneous murmur accompanies the emission of so much water, which, divided into myriads of globules, falls back in the same vessel (now in the form of a large artichoke) from which it springs, and is lead, by

lateral pipes to the Sprudel-baths, to the evaporating salt-apparatus, and to the river flowing near it. The height of the springs can be more or less increased, according to the breadth and length of the square wooden pipe, through which the water ascends; but it remains nevertheless a springing fountain, even when left in a state of nature, deprived of its outward constructions. A peristyle, a long colonade, the elegant hall of the bath-house, a flower-garden, with a good band of music, offer to innumerable drinkers an agreable walk, during the whole season, whatever may be the weather.

The Mühlbrunn (45° R. or 135 F.), the Neubrunn (50° R. or 147 F.) and the Theresienbrunn (43° R. or 132 F.) on the left side of the Teple, communicate together, and are decorated with elegant buildings, colonades and gardens. The Schlossbrunn (40° R. or 122 F.) is much less frequented, on account of its high situation. The cavernous Bernardsbrunn is scarcely accessible to drinkers, but its abundant water, nearly as hot as the Sprudel, is led into a reservoir, necessary for cooling the Mühlbrunn-baths. Some ophthalmic patients use its vapour at random without medical advice. Aware of the dangerous consequences of such an empirical application, I suggested to an eminent oculist, Dr. Ryba, of Prague, the necessity of reducing to rational principles the indications and counter-indications, according to which that vapour may be beneficial or hurtful (*Almanach de Carlsbad*, 1834, ch. VIII).

The Spitalbrunn supplies the baths of the Saint Bernard's Hospital, and is not frequented by other invalids.

Which ever of the springs patients are recommanded to, they regularly come from six to eight o'clock. Some of them drink a few goblets in the evening. The interval prescribed between one beaker and the other being a quarter of an hour, scarcely more than nine or ten beakers can be taken during two hours. Such a quantity proves sufficient in most cases; many patients, however, going far beyond that number, begin earlier. Few places in Europe offer, upon such a small spot, a more remarkable diversity of ranks, professions, countries, tongues, religions and costumes. Medical doctrines, rational or empirical, never had any influence upon the number of its visitors, which has always been increasing.

Carlsbad has been often, and not improperly, called an elegant *hospital*. Though many invalids, unable to walk, drink in their lodgings, by far the greatest number attend the wells:

Dulciùs ex ipso fonte bibuntur aquae.

Abdominal diseases being here the most frequent, no where perhaps can jaundice and sickly complexions be seen under more forms and degrees. Most people attributing to the Sprudel an imaginary supremacy, melancholy, misanthropic and hypocondriacal patients shew a particular predilection for that fountain. If those sickly and sinister faces offer a painful sight,

rapid changes take place, and the same invalids, walking, on their arrival, pensive and bent, avoiding company, and exciting commiseration, begin often, and very soon, to look better, to speak with gratitude of their improvement, and to contract gradually more sociable habits.

ANALYSIS

OF THE

WATERS, AND THE CARLSBAD SALT.

About the middle of the sixteenth century, C. G. Springsfeld and J. G. Tilling, saxon physicians, attempted to analyse the waters of Carlsbad; but why should we recall at present the proceedings and notions of infant chymistry?

We are indebted to David Becher, of Carlsbad (born in 1725, † 1792), whose multifarious merits can not be too much praised, for the first regular analysis of our waters, in 1770, and Berzelius himself, in 1822, expressed the highest admiration for the talent and chymical knowledge displayed by Becher, with such imperfect means. He examined the Sprudel, the Neubrunn, the Gartenbrunn (now Theresienbrun), and the Schlossbrunn, and found in all the same constitutive parts, viz:

sulfate of soda	2,52	parts
carbonate of soda	1,54	„
muriate of soda	0,87	„
carbonate of lime	0,56	„
iron oxid	0,06	„
	5,55	parts.

A later analysis by the celebrated Klaproth, of Berlin, who visited Carlsbad, in 1789, proved so similar to that of Becher, that, instead of relating it, I shall only give here the result obtained, in 1822, by Mr. Berzelius, who not only confirmed what had been found previously, but discovered many other constituent parts, unknown to his predecessors. His analytic proceedings are well known to learned chymists.

"The Carlsbad water," says he, "is clear and "colourless. Drunk at the wells, it tastes like weak "chicken-broth; but, after some time, it contracts an "alkaline and disagreable taste. It has no smell, and "the existence of sulfurous hydrogen gaz is not to be "detected by any test. Heated in a closed vessel, it "deposits a very small quantity of a light yellowish "sediment, the colour of which indicates evidently an "oxid of iron. The specific weight of the water is "+ 18° C 1004,975. I weighed the Sprudel, the "Hygiaea, the Mühlbrunn, the Neubrunn and Spital-"brunn water, and found precisely in all the same "specific weight."

As collective result of all his analytic experiments, Mr. Berzelius found in 1000 parts of weight of the Sprudel water:

sulfate of soda	2,58713
carbonate of soda	1,26237
muriate of soda	1,03852
carbonate of lime	0,30860
fluate of lime	0,00320
phosphate of lime	0,00022
carbonate of strontian . . .	0,00096
carbonate of magnesia . . .	0,17834
sub-phosphate of alumine	0,00032
carbonate of iron	0,00362
carbonate of manganese . .	0,00084
silice	0,07515
	5,45927.

He ascertained in the Mühlbrunn, Neubrunn and Theresienbrunn, not only the same constituent parts, but he found them precisely in the same proportions as in the Sprudel water.

As to the quantity of carbonic acid gaz, Becher found as much of it in the Carlsbad water as its bicarbonates could contain.

It appears that the Sprudel, as it issues from the wells, contains a little more carbonic acid gaz than the quantity of the bicarbonates.

The Theresienbrunn contains besides 1% of azote.

The celebrity of Mr. Berzelius and his analytic proceedings, forming a new aera in the chymical investigation of mineral waters, are of the highest importance in our medical practice. They should calm at least the anxiety of invalids, and rectify sundry

erroneous notions, adopted too slightly, even by physicians, about material differences between one spring and the other.

The Carlsbad salt (sulfate of soda), extracted since 1708, on the advice of Gottfried Berger, physician to Augustus I, king of Poland and elector of Saxony, at the expense of much fuel, is obtained, since Becher recommanded it, by the mere evaporation of the mineral water. A number of kettles, filled with it, are dept in the same water. That water is constantly renewed by streams of the Sprudel, in the vicinity of which that simple and cheap operation can be seen by any one passing near it. The residuum is freed from its calcareous parts by a second operation in larger vessels, and in a cooler place, where the crystals form themselves.

The Carlbad salt, a revenue of some importance to the town, is often prescribed to drinkers, to assist the purgative effect of the waters; and many provide themselves with one or two pounds of it, to be used, if necessary, after their departure. The salt is sold, under public authority, in boxes of various size, with the town seal. The usual dose is from two to four drachms, dissolved in water.

Various experiments and calculations have been made, to ascertain the quantity of sulfate and carbonate of soda, which the Sprudel alone, by its various orifices, might produce. The apparatus used hitherto for that measurement, was no doubt very imperfect, but a mere view of the abundant fountain will

convince any one of the enormous quantity of Sprudel water running to no purpose into the river. Klaproth calculated approximatively that one could obtain yearly 746,884 ℔. of sulfate and 1,32,923 ℔. of carbonate of soda; whilst another chymist, Mr. Gilbert, finding erroneous the basis of Klaproth's calculations, estimates the yearly quantity of those two salts to 200,000 quintals of carbonate of soda. Considering the advantages which might arise from the extraction of such an enormous quantity of soda in a country, like Bohemia, where so much glass is manufactured, several speculators have been struck with the utility of an undertaking, which Mr. Berzelius (*Almanach de Carlsbad,* 1835, ch. III) thinks easy and infallible. The citizens of Carlsbad, it is true, believe still that whatever is extracted from their springs and sold abroad, must be detrimental to the prosperity of the place; but such prejudices would easily give way to rational consideration.

INSUFFICIENCY
OF THE
THEORIES PROPOSED FOR EXPLAINING THERMAL HEAT.

"No stranger," says Mr. Berzelius, "contemplates "the boiling and springing Sprudel without asking "whence its temperature proceeds. The answer is the "more difficult, as in the absolute impossibility of "reaching the hearth which imparts it, we shall never "know the means employed by Nature to form it, nor "how that water is impregnated with substances, of "which, as far as investigations have shewn, the "mountains of Carlsbad contain too little to account "for the enormous quantities of sulfate and carbonate "of soda, emitted from the wells, in the course of "only one year."

"It is highly probable," adds he, "that the heat "and nature of the substances, which impregnate this "water, are so closely united, that the cause of

"thermal temperature will not be explained as long "as the place from which those ingredients proceed, "remains unknown."

The problem of animal heat has not engaged the attention of more eminent men, than the cause of the high temperature of the Carlsbad waters. Bohuslas de Lobkowitz proposed poetically that question (p. 11), and, after him, a series of learned physicians, chymists, mineralogists and geologists: Frederick Hoffmann, Gottfried Berger, Bruckner, B. L. Tralles, David Becher, Klaproth, Leopold de Buch, Gilbert, Berzelius, de Hoff, offered, instead of proofs, ingenious conjectures; each pointed out the weak sides of his predecessor's opinion, and proposed a new theory, but all acknowledged the impossibility of ascertaining the operations of that deep and mysterious boiler, anterior to history, coeval to Creation. Masses of hornstein, of sulfuret of iron, of fossil coals, imbedded in the granite of Carlsbad, volcanos, earthquakes, revolutions of the globe, comparisons between the external forms of our environs with those of such regions (France and Iceland), where hot springs are found; subterraneous electric or galvanic action; violent friction of vegetable, animal, bituminous substances, heated to ignition; erudition, sagacity, analogy, every means in short have been tried to resolve the problem of thermal temperature; but, in our dark ignorance of the anatomy and physiology of the bowels of the earth, of which we scarcely know more than the integuments, that gordian

knot has neither been untied nor cut through. Those researches have in some respects promoted science, without however teaching us where the subterraneous laboratory lays, in which the Almighty prepares the mineral ingredients of our waters; out of what storehouse he draws them; how he mixes and heats them; nor by what ramification of channels he leads them, in mercy to mankind, to the various orifices, where a sickly multitude flocks annually, to partake of the blessing. "Should we not believe," said Galen, speaking of thermal waters, above two thousand years ago, "that Vulcan and all the Cyclops of his retinue, "are incessantly blowing and stirring up the fire of "their subterraneous furnaces, to maintain a tempe-"rature so equal and so constant?"

I have only named here learned men who have attempted to explain the heat of our waters; french, italian and german men of science have paid equal attention to the phenomenon, but with as little success, in their respective countries.

ANCIENT AND PRESENT MODE OF USING THE WATERS, AND CHOICE OF THE SEASON.

THE very name given to the town by its founder, Charles IV, proves enough that Carls*bad* acquired its first renown as a bathing establishment. Lobkowitz, singing the virtues of our springs, speaks of *bathing*, not of drinking:

Quisquis in hâc lymphâ fragiles immerserit artus.

Wenzel Payer tells us, in 1521, that drinking was rare, and bathing usual: *Et quia hucusque (aqua) non fuit in frequenti usu quoad potum, sed magis ad abluendum.* Carlsbad being formerly recommanded to sterile women, he says that the water would prove useful to a greater number, if, instead of bathing, they would drink: *Quod autem multae mulieres in hoc casu (sterilitas) redeunt sine levamine, causa est malus ordo, quia balneant in balneo*

(at Carlsbad) *et nunquam bibunt ex eo.* Persons labouring under cutaneous disorders, leprosy and other external evils, drove then to Carlsbad. We see there now more diseases arising from visceral obstructions. Mathaeus Collinus de Choterina (born in 1516, † 1566), a good poet and a celebrated professor of the Greek language at the University of Prague, (where the marble monument erected to him is still to be seen), expresses, in the following lines, his wishes that a powerful friend of his, going to Carlsbad, may be cured of the *itch*, and the consort of that friend, of her *sterility:*

Unda tepens vestros scabie, precor, allevet artus,
Foecundam sociam reddat et illa tuam

Payer's advice was slowly adopted, and great vicissitudes have been observed, since his time, in the mode of bathing and of drinking. Formerly, and particularly during the sixteenth century, patients remained six or eight hours a day, and even longer, in the bath. A specimen of that extraordinary method, still followed at Louèche (Leuk), and in other Swiss Baths, is described in the very remarkable Journal, kept in 1571, at Carlsbad, by Dr. George Handsch of Limusa, physician to archduke Ferdinand of Tirol and his wife Philippine Velser, of Augsburg. That journal, published in my *Almanach*, for 1832, ch. V, is unquestionably the most instructive document we possess on thermal practice during the middle age. Philippine submitted, with an angelical resignation, at

the same time, and during five weeks, not only to frequent pharmaceutic purgatives and water drinking, but she bathed six or seven hours daily. The irritation of the skin, produced by these protracted baths, gave to that method the name of *corrosio cutis,* in German: *Hautfresser.* In Switzerland it is called *la pousse* or *la poussée.*

David Becher, in his excellent Treatise on the waters of Carlsbad *(Neue Abhandlungen von dem Carlsbade, 1772),* speaks of the skin-biter, as completely abandoned, and draws his description from Fabian Summer's work: *De inventione, descriptione, temperie, viribus et imprimis usu Thermarum D. Caroli IV Imperatoris libellus brevis et utilis.* Lips. 1571 et 1589.

The advantages of the internal use of the waters confirmed by so many favourable cases, bathing was gradually neglected, and, though never abandoned, it became at last a secondary part of the treatment. That neglect was felt, and often blamed, by national and foreign physicians of eminence. Habits of comfort and luxury increasing and spreading rapidly in the principal German watering-places, our patients shewed so little inclination to bathe in uncomfortable and narrow private rooms, that better institutions became indispensable. Maria-Theresia ordered, in 1762, to build, at her own expense, a bath-house near the Mühlbrunn, demolished, in 1827, as incompatible with the increase of visitors, and placed on the opposite side of the street, upon a far better

plan. Another beautiful bath-house was erected, in 1831, near the Sprudel, and the Hospital-Baths, without speaking of those which every one can take in his own lodgings, prepared with Sprudel water, pure or mixed with the river water, according to medical prescription. Every house owner is provided with a bathing-room, a bathing-tub, and buckets to carry the water.

According to comparative experiments made last year by Dr. Romberg of Berlin and myself, in order to ascertain a point contested by many, the Sprudel water lost $21\frac{1}{2}^{\circ}$ R., and common water, artificially heated, 33° R. in half an hour.

The advantages of steam-baths had long been praised, and patients at Carlsbad had now and then imagined some imperfect mode of applying vapour in various ailments, rheumatism, gout, contractions of limbs, but without any methodical principles. Fabian Summer, a native of Carlsbad, speaks, in 1571, of *Sudaria communia*, without describing that *sweating establishment*, so that now no body knows whether they were, like russian baths, prepared with the vapour of common water, or composed of the Sprudel vapour, which requires another mode of application, on account of its effects upon the organs of respiration. Enormous clouds of vapour rose, during ages, from our hot wells, lost in the wide atmosphere. The first impulse was at last given to vaporous medecine by the celebrated Mr. d'Arcet and Dr. Galès, of Paris, who invented boxes for sulphurous fumigations.

Tempted by the *Reports* which the latter published in 1816, I established, in 1817, at Vienna, fumigating rooms, and sent a great number of my improved boxes to medical practitioners in most countries of Europe, and even two to London, for public and private establishments. The good effects of those fumigations, the perfection of the apparatus, suggested soon the idea of applying medically the steam of various hot wells. Carlsbad was one of them, and no where perhaps could one dispose of more copious vapours. On my arrival there, in Mai 1826, I found the walls of a new building erected for that purpose, above the source of Hygiaea. Knowing the experience I had acquired at Vienna in that branch of medical practice, my advice was requested by Government for the construction of the necessary boxes, and other furnitures. The Vienna apparatus were adopted, with the modifications which a vapour so different from the sulfureous fluid required; six of them and twelve small rooms compose the establishment. Some additions, but no corrections, have since taken place. The partial application of a steam-douche; the possibility of taking a whole bath or a half-bath; of applying partially the vapour to the superior or to the lower extremities, to the breast and to the ears, have given to the establishment a high degree of perfection, and met with general approbation.

We are hitherto rather deficient in the applieation of the water-douche, but the improvement of that

important branch of thermal practice is at this moment a subject of serious consideration at Carlsbad. The want of good douches is the more surprizing that the following quotation, from Wenzel Payer's work, seems to prove that Carlsbad was the first place in Germany, where that powerful remedy was introduced: *Et miror saepe mecum quod nullus medicorum per Germaniam dutiâ* (douche from *gutta*, gocchie) *utatur*, *quia in nullâ patriâ*, *magis necessaria esset.* It is at least probable that Payer, having learned the utility of the *douche*, did not neglect to establish it at Carlsbad.

Our medical institutions can be therefore divided into three distinct periods. During the first, bathing alone was usual. The second period, and certainly the most important, dates from Wenzel Payer, on whose suggestion, in 1521, the internal use of the waters was added to bathing. The third began so late as 1827, when the application of steam was joined to drinking and bathing. The junction of these three curative means has manifestly increased the fame of Carlsbad, and, although often prescribed to the same patient, drinking remains in general the most essential part of the cure. A great number accomplish it without water or vapour-baths; but bathing without drinking is rare.

Formerly, when the purgative effect of the waters was deemed the most important, physicians encouraged plentiful drinking; but, since their *alterative* and *slowly desobstruent* action has been better under-

stood, and since it has been ascertained that alvine evacuations are seldom proportioned to the quantity of ingested water, they have less insisted upon the necessity of immoderate drinking, and patients are in general desired not to overpass that degree of saturation, which borders on reluctance. Prodigious deeds are told of our vigorous ancestors, and good folks are inclined to consider the present moderate dose of seven or eight goblets, as a proof of the degeneracy of our species, of which Juvenal complained, about two thousand years ago, as having already commenced in Homer's time:

Nam genus hoc vivo jam decrescebat Homero;
Terra malos homines nunc educat atque pusillos.

The fact is that patients offer very different capacities of swallowing and digesting mineral waters, as gluttons and drunkards beat sober people in eating, and in drinking wine or beer; and that we still see at Carlsbad individuals who would astonish their forefathers, if they saw them taking from thirty to fifty goblets as a daily portion. Such drinkers are rare, but they exist (*Almanach* for 1833, ch. IV). The capacity of our beakers being, since the middle of the eighteenth century, exactly the same (six ounces), our present observations are far more accurate than those of our predecessors, whose patients came to the wells, or drank at home, with all sorts of cups, so that we scarcely know now, when we read ancient authors, the size of their *pocula, cyathi,*

canthari, seidlini, nosellini, etc. A celebrated Bohemian historian, Balbin (*Miscell.* Lib. I. c. 24), tells us, in 1697, that the Carlsbad beakers did not contain more than two ounces and a half of liquid. The coffee-cup, of Saxon porcelain, kept in the National Museum of Prague, out of which the Austrian empress Elisabeth, princess of Brunswic-Wolffenbüttel, wife of Charles VI, drank our waters in 1721, contains only four ounces and two drachms of liquid. (*Almanach*, for 1831, ch. XXII).

The season begins, with few exceptions, the 1st of May, and finishes with September. Our waters acting not only upon the bowels and kidneys, but promoting perspiration, and requiring of course warm weather, June, July and August are always at Carlsbad the fullest time of the season. Those who are fond of a brilliant crowd, and not afraid of paying higher prices for lodgings, should come from the 15th of June to the 15th of August; but those to whom a bustling life is rather an annoyance than a pleasure, should be here from the 1st of May to the 15th of June, or from the 15th of August to the 30th of September. Society, in the beginning and towards the end of the season, being much less numerous, invalids can enjoy the comforts of a quiet life, and they meet with fewer opportunities to transgress the laws of the cure, the length of which varies from five to six weeks, and is even, according to circumstances, continued still longer, sometimes also interrupted by a pause or an excursion, and

reassumed. Such advantages offer some compensation for the greater chance of a warmer temperature, variable at all times in our deep valley. Besides, real invalids, who require frequent attendance from their physician, can better expect it than in the middle of the season, when the best will is not always sufficient to visit patients as often as some of them wish it.

MODE
OF
ACTION OF THE WATERS.

Soda, as we have seen, being the principal ingredient of our hot springs, their effect can mostly be attributed to that alkali, whatever may be the auxiliary action of their other constituent parts, some of which, discovered later, are in exiguous quantity.

Soda acts with energy on the animal economy, and has a hurtful influence on the arterial system, disposes to hemorrhagies, to scurvy, and disturbs digestion. The Carlsbad water, on the contrary, during the longest cure, animates and vivifies, excites appetite, promotes digestion, and, united to proper regimen, favours the return of health. The difference between the effects of pure soda, and those produced by our waters, can not be otherwise explained than by the union and combinations of that

alkali with their subtler parts, such as the oxid of iron, the carbonic acid gaz, and the new ingredients, found by Mr. Berzelius (without speaking of those which may perhaps be hereafter discovered), and particularly by their high temperature, which, volatilizing those constituent parts, so wonderfully united and combined together, conveys them, by the finest ramifications, to the last extremities of our organism, imparts to them a vivifying power, and deprives them of their hurtful qualities. David Becher, whilst drinking our waters, found Carlsbad salt in his own urine, and some drops of his perspiration, gathered upon a watch-glass, examined with a strong microscope, showed, during their evaporation, crystals similar to Carlsbad salt.

It is undoubtedly as difficult to tell by what process alkaline water separates, moves and eliminates morbid matters, as to understand how mercury, introduced by the stomach or the skin, frees the animal economy from inveterate syphilitic affections. Without attempting a methodical solution of this problem, one can conceive how an alkaline substance, reaching, more or less slowly, the last ramifications of our secretory and excretory organs, produces effects not to be expected from coarser medicaments, administered only in small doses, such as antimony, gums, soap, ox-gall, vegetable juices or extracts. Whoever has experienced at Carlsbad a regular crisis, will never more question the power of its waters, the revolution they cause in the whole system, nor the artificial

disease excited by such perturbations. The Germans call it very properly a *Bad-Sturm* (bath-storm).

This hot water occasions neither nausea nor vomiting; it has an exciting action on the stomach, the bowels, kidneys, liver and other abdominal organs, of which it augments the secretions and excretions. Its action upon the alimentary tube produces a purgative effect; it acts particularly on the blood-vessels, creates often orgasmus and palpitations, and drives the blood to the head. It increases indirectly the activity of the lymphatic system, and it only begins to be tonic, after having brought on secretory and excretory effects. Such are the characters distinguishing Carlsbad from the more chalybeate and gaseous waters, which are more directly tonic.

Abundant purgation is not indispensable to the success of the treatment, and, in many cases, the best results are obtained by copious urine and perspiration; but that all these effects should be simultaneous, is still more desirable. At all events, costiveness should be obviated, and, with that view, we recommand a few additional drachms of Carlsbad salt, Püllna bitter water, glysters and the like.

These various modes of operation have always determined and regulated the use of our waters, and given them the first rank among the remedies commonly called *desobstruent* and *alterative,* in innumerable disorders, proceeding from stagnation and obstructions of the blood-vessels, or of the organs copiously provided with them, from which a variety

of abdominal complaints can arise, such as weakness of the stomach, heart-burn, acidities, swelling, eructations, costiveness, which, complicated with derangements of the nervous system, obstruct the liver, the spleen, the mesentery, the epiploon, produce biliary concretions, jaundice in all its degrees, hypocondriasis with its visions, fluent and blind piles, head-ach, vertigo, and all sorts of arthritic, herpetic and urinary complaints.

Hypocondriacal affections appear no where under more various forms than at Carlsbad; and the misanthropic and pusillanimous feelings of those unfortunate beings, passing, without known motives, from hope to despondency, from moroseness to exaltation, deserve the greatest indulgence and sympathy, When we see so many hepatic and splenetic patients whose temper depends entirely on the state of their abdominal functions, we feel disposed to forgive the materialism of the ancients, who placed the seat of so many passions in the liver; we remember unwillingly the *Fervens difficili bile tumet jecur,* the *jecur ulcerosum* of Horace, as synonimous of *jealousy* and *violent love,* and we understand how they could say that men *splene rident, felle irascunt, jecore amant, pulmone jactantur, corde sapiunt.*

COMPLAINTS
WHICH
CARLSBAD CAN CURE OR RELIEVE,
AND THOSE
WHICH IT AGGRAVATES.

It would be quite impossible to describe all the complicated diseases which we treat at Carlsbad, and upon which we are called to give our opinion. What has been said in the preceeding chapter, will however sufficiently point out the cases in which our waters can be recommanded. Chronic affections offering in general an immense field, we cannot say with precision where their efficacy begins and where it ends. Practical tact and a thorough investigation of the symptoms must help practitioners in their judgement; but few mistakes will occur, if they pay due attention to the following classification, given above sixty years ago by David Becher, which, in spite of all the vicissitudes of medical doctrines and nosological nomenclatures, remains still the most rational. I shall

add to it, some miscellaneous observations, without systematic order, upon various essential points of our practice.

The virtues of the Carlsbad waters, says Becher, can be reduced to five principal effects:

1. They correct the weakness of the *primae viae,* free them from matters collected and accumulated there, even when inveterate.
2. They resolve and dissipate obstructions, particularly those of the abdomen.
3. They correct, change, evacuate the acrimony of the blood, or drive it towards the lower extremities or the surface of the body.
4. They expell from the urinary passages sand, gravel and calculi.
5. They have often proved very beneficial in many serious disorders, produced by occult causes, difficult to point out.

The last paragraph shows particularly the great utility of providing patients sent to Carlsbad with a good history of their complaints, which are in general complicated, obstinate, and arise from a variety of causes, climate, mode of life, etc. Such invalids, careless about the past, lay often the highest importance upon insignificant circumstances, and say nothing about those which would throw light upon their case. As to instructions, about the mode of drinking, bathing, *douching*, and steaming, as well as about regimen and diet, which of course should be entirely

regulated by the medical adviser, to whom they apply at Carlsbad; such instructions, written or printed, which many physicians think proper to give to their patients, are absolutely useless, and often attended with disagreable consequences, if there happens to be diversity of opinions between those instructions and the precepts of the local physician. The worst part of our functions is to be consulted for diseases which Carlsbad can only aggravate, and to find ourselves in the painful necessity of declaring to such patients, that they would have done better to stay at home. Such mistakes, caused by an imperfect knowledge of the effects of our waters, are but too frequent. Supported by hope, the journey to the wells was at least tolerable; but, deprived of all further illusions, the way home is dreadful. More than one arrives here every year to be buried, without having been able to drink a single drop of the water from which he expected recovery, or at least great relief.

They never agree with an inflammatory state, general or partial, nor with symptoms of orgasmus, congestions and vertigo, which must be removed by appropriated means, before the water is administered. Should such accidents take place during the cure, it must be interrupted.

They are decidedly hurtful in every degree of pulmonary phthisis; to individuals disposed to hemorrhagies, and still more during hemorrhagies; they accelerate and increase the pulsations and dilatations, and consequently the rupture, of anevrisms; they

aggravate all syphilitic complaints, but they can be tried, as touch-stone, in doubtful cases of that morbid principle, which they generally awaken, if dormant. I have seen them however stop chronic and indolent blenorrheas, after the inflammatory and painful period had ceased, when the gleet does not proceed from strictures of the urethra, indurations of the prostate and other organic disorders of the urinary passages.

They aggravate scorbutic affections, and accelerate often the disorganization of abdominal scirrhous parts, when too far advanced. They are in general dangerous in dropsy, though we have seen them succeed in a few cases of anasarca, without visceral indurations of too long standing. If a physician thinks himself justified to try them in dropsical cases, the utmost circumspection and very small doses are necessary. The most delicate part of our practice is to draw a line of demarcation, and to determine, in abdominal diseases, whether the affected part is already in a state of disorganization; and, where consumptive and hectical symptoms have began, whether the waters can be tried, or whether we must refuse them to such individuals. I shall relate a most remarkable case, where I tried them rather unwillingly, following the axiom: *Potiùs remedium anceps quam nullum:*

An English lady, four and twenty years of age, the last of a family swept off by consumption, had enjoyed good health, till she married, in her seven-

teenth year. After her first confinement with puerperal fever, in 1821, she lingered fifteen months. The existence of gall-stones being suspected, she was sent to Cheltenham, whose saline waters brought on a miscarriage (at Carlsbad we never allow pregnant women to drink), followed by an excessive weakness, which yielded to proper regimen and the sea-side. In 1823, she was happily delivered of a third child, which she lost, ten months old, whilst again pregnant of another, still alive and healthy. Her husband having been suddenly called to sea, she lived in continual anxiety, and was seized with a fever, that alarmed her physician, because the delivery was approaching, which however was easy and regular, but followed by an inflammation of the bowels and liver. She was twice bled, twelve ounces each time, and leeches were applied to the temples, on account of violent head-ach. Some milk is said to have been seen swimming in the blood drawn from her, and since that time she always lingered. A second inflammation of the liver was also subdued by copious blood-letting. She tried again successfully the sea-side. Pains in the liver and the head, with a violent fever, returned, in 1826; and, after a convalescence of two months, she had an inflammation of the lungs, for which, in less than twenty-four hours, she was twice bled *ad deliquium animi,* to the enormous quantity of twenty-two and of eighteen ounces, beside innumerable leeches, blisters, etc. In October 1825, her husband returned from the West-Indies to Eng-

land. They went to Pisa, Leghorn and Rome, where she became daily worse, affected with pulmonary symptoms, night-sweats, fever, excessive weakness, etc., so that her life was despaired of. A gentleman, coming from Carlsbad, whose waters he had drunk under my direction, for various ailments subseqnent to the yellow fever he had undergone at Antigua, advised that lady, though no medical man, to make haste for Carlsbad, quoting his own case, quite different from hers. On her arrival (27th of June 1827), finding in her almost every symptom of hectic fever, cough, excessive weakness, absolute impossibility of standing on her legs, still less of walking, I could not allow her to try the waters, her last hope. I begged of her to wait a fortnight, to allow me to observe her daily, and I advised her goat-milk. The pulmonary symptoms were so much relieved, that, after the stipulated time, I allowed her to try the waters, beginning with two beakers, which I increased, without any inconvenience, to eight daily. The improvement was gradual, and indeed wonderful. She lost her cough, got some embonpoint, and recovered strength enough to take long walks, an airing in a carriage or on a donkey; her good humour returned; in one word, her recovery, from the moment she experienced the desobtruent effects of the waters, became an object of general astonishment and admiration. For the consolidation of her cure, or rather, as she said, out of gratitude, she came again, in 1828 and 1829; she closed even, against my advice, an

issue, which had been applied three years before on the region of the liver, without any bad consequence; and, in 1831, she was brought to bed of an healthy child.

In this case, therefore, the liver was evidently the principal seat of that lady's complaints, and the pectoral symptoms, the hectic fever, and complete loss of strength, only secondary and aggravated by immoderate bleeding. Had the pulmonary affections been the primary disease, our waters would have undoubtedly accelerated her death, which seemed approaching, when she arrived at Carlsbad.

MISCELLANEOUS PRACTICAL OBSERVATIONS.

HABITUAL COSTIVENESS.

A great number of patients, in consequence of a sedentary life, of studious habits, daily abuse of opening medecines, come to Carlsbad without other complaints than habitual costiveness. Our waters remove in general that torpidity of the digestive tube, restore the regularity of its functions and appetite; but such patients, if they wish their cure to be permanent, must absolutely give up those auxiliary means, and join to the use of the waters a regular regimen. We see often individuals affected with a variety of abdominal disorders, and their direct and indirect consequences upon digestion, upon the nervous and cutaneous systems, without being able to discover the least induration or increased sensibility by the touch; but their yellow complexion and their

hypocondriacal and melancholy feelings evince the abdominal nature of their case, and the necessity of drinking desobstruent waters. Though English visitors have not been hitherto so numerous as patients from all other parts of the world, that slavery to purgative medecines, that fondness for mercurial preparations (calomel or *blue pills*), that apprehension of danger, if four and twenty hours pass without having their bowels *cleaned*, have been particularly observed among them. Many physicians of eminence, such as Dr. James Clarke, of London, and Dr. John Abercrombie, of Edinburgh, have of late strongly blamed that national predilection. I shall not repeat here their arguments, founded upon extensive experience; but I have attended many English invalids, who, after a regular course of our waters, felt no more the want of mercurial or other drastic and irritating purgatives, as well as I have seen immoderate eaters, great drinkers, and lovers of refined cookery, contract here salutary habits of frugality and temperance.

BILIARY AND URINARY CALCULI.

The renown of Carlsbad for the expulsion of calculi seems to be old standing, and, according to the Journal kept in 1571 by George Handsch of Limusa,

Philippine Velser laboured under such concretions. We see every year a great number of patients, in whom their existence is manifest, or at least very probable; others bring with them, as proofs, the specimens they have collected. I remember, amongst others, a patient, with an indurated liver and jaundice, who, after having drunk only three days, evacuated innumerable gall-stones, about the size of small and large peas, with which he filled several boxes. A most remarkable patient of mine, an Italian nobleman, voided daily, during two months without interruption, a good tea-spoonful of gravel, and numberless gall-stones, of very different size. I counted once 270, passed in four and twenty hours, of the usual yellow (ginger-bread) colour, but some of them sky-blue. He never felt any pain nor any derangement of health from those double concretions, except an excessive moral anxiety about their prodigious abundance, attended besides with continual borborygms, attributed by some to a collection of gas, by others, to a collection of water, in the bowels themselves, or between them and the peritoneum. This patient, after having drunk during two months, tried the Franzensbad waters, which are chalybeate and acidulous. They stopt both evacuations; he came back to Carlsbad, where, as soon as he began again to drink, both excretions (sand and gall-stones) took place, as copiously as before. I observed, during two seasons, this singular case, but the patient returned to Italy, and gave no further account of himself. The sky-blue

concretions, which he jocosely called his *turquoises,* are an excessively rare phenomenon. A year after, I saw again a few blue gall-stones, evacuated by a Russian field-officer, who, during the campaign in Persia, caught a most obstinate intermittent fever, in consequence of which he was sent to Carlsbad. Those blue concretions drew the attention of many eminent physicians; unluckily no analysis took place, but all sorts of conjectures were hazarded on the origin of that colour, amongst others an ingenious one, proposed by a learned Saxon gentleman, founded upon the presence of copper, which analytical researches have proved to exist in several articles of our daily vegetable and animal food. (*Almanach* for 1833, ch. V.). The celebrated J. G. Walter, of Berlin, collected innumerable gall-stones, described, after his death, by his son Frederick-Augustus, in the *Anatomisches Musaeum*, I. Th. Berlin. 1796. Some blue ones are to be seen, Plate II et IV.

The most extraordinary case of biliary concretions expelled by the action of our waters, has been published by Dr. Leo († 1729), with the analysis of those concretions by Dr. Pleischl, professor of chemistry at Prague, under the title of *Merkwürdige Krankengeschichte einer Gallenstein-Kranken, nebst der chemischen Analyse und Abbildung dieser Gallensteine und des krystallisirten Cholestrins.* Prag, 1826. Every one of the four biliary calculi, evacuated at Carlsbad by Leo's patient, a Saxon lady, sixty-five years of age, are, according to the very correct

picture annexed to his Memoir, as big as middle-sized walnuts. Though the similarity of their composition with other gall-stones was proved by the analysis, it was questioned whether they had been formed in the gall-bladder or in the intestinal tube. Their dimension appeared indeed so much out of proportion with the usual diameter of biliary ducts, that the belief of their formation in the gall-bladder must partly rest upon the well-known and astonishing power of dilatation and contraction possessed by certain organs, whilst the explanation of their formation in the alimentary canal offers still greater pathologic difficulties. The excruciating pains which attended the evacuation of those enormous concretions and the cholestrin found in them, are sufficient proofs of their formation in the gall-bladder. Such is at least the opinion of the learned professor, Dr. Pleischl.

In a great number of cases, the violent pains in the vicinity of the biliary organs, the sudden cessation of those pains, a visible change in the complexion, and even the total disappearance of the jaundice, leave no doubts about the existence of gall-stones; but, if their passage through the alimentary tube is probable, they cannot always be detected. Most patients are careless about ascertaining the fact; many feel reluctant to trouble their physician with this loathsome investigation; in short, various circumstances render it more or less difficult, and, in order to be conclusive, the examination should take place every day. I attended last year a lady, whose

frequent pains about the pit of the stomach, were so violent, and the variations of her yellow complexion so sudden, that neither of the two physicians who had attended her for two years, nor myself, could doubt of the existence of gall-stones. The above-mentioned investigation took place, but perhaps not often enough, and without result. Her excruciating pains brought on frequent cataleptic fits, during which she stretched her arms, and joined her hands in the attitude of prayer; she remained then, with staring eyes and absence of mind, above a quarter of an hour, in that state, till the fit subsided and was followed by the three stages of an ague: shivering, heat and perspiration, which lasted a few hours. The storm over, she only felt fatigued, but was soon well enough to go out, to walk and to attend to all her social duties. The waters operated copiously, her urin was turbid and yellow, and she had at Carlsbad only one cataleptic fit, of which I was eye-witness. Having experienced moral affections of a grievous nature, she had two or three slight ague-fits, but no cataleptic symptoms.

In cases of sand and gravel, our waters are particularly efficacious. George Handsh tells us, in the Journal he kept in 1574, that archduke Ferdinand was freed at Carlsbad from three urinary calculi, one of which was *as big as an almond;* and P. G. Schacher wrote, in 1711, an interesting paper: *De thermarum Carolinarum usu in renum et vesicae calculo.* I have attended a great number of patients,

afflicted by such diseases. The effect of our waters is powerful, when those concretions do not overpass the diameter of the urinary passages, but little is to be expected from their lithontriptic action upon bigger stones. Their solidity and composition being very different, the effect of the water cannot be the same upon all, and we have not the means of ascertaining their nature in the human body. The best authors, particularly Becher, pretend, and many cases have confirmed to me the truth of their observation, that our springs correct and destroy the tendency to a formation of stones *(lithiasis)*, and of late French lithotomists and lithotritists, among them Dr. Civiale himself, have sent to Carlsbad patients successfully operated, to prevent the reproduction of calculi.

ARTHRITIC AND HEMORROIDAL DISORDERS; CHLOROTIC AND OTHER FEMALE MALADIES; METALLIC INFLUENCES, ETC.

Arthritic and gouty disorders, every where so frequent and so cruel, find here essential relief, and sometimes their complete removal. Becher, after thirty years practice, affirmed that one third of the patients he had treated at Carlsbad, suffered more or less from that morbid principle. A physician,

his predecessor, P. G. Schacher, wrote a good Essay on this subject: *Dissertatio de thermarum Carolinarum usu in arthritide.* Lips. 1709.

The Carlsbad water, acting with so much energy upon secretions and excretions, and strengthning secondarily our digestive organs, must prove useful in various forms of arthritis, so frequently combined with abdominal disorders. Experience and observation confirm every year that principle; but we can scarcely expect to entirely remove by the waters those calcareous hard concretions, which, in their advanced state, tumefy the joints. They are particularly efficacious in the wandering gout *(arthritis vaga)*, provided patients adopt, not only during the cure, but after it, a proper regimen, and give up luxurious and epicurean habits, so apt to produce and to increase gouty disorders. We see often such dormant evils, roused by the use of the waters, which also cause pains and inflammation of the joints; they frequently bring forward herpetic and other eruptions, which relieve these pains; they even sometimes excite spontaneous blisters and vesicles of various sorts; they very often produce oedematous swellings in women's feet, which disappear as soon as they give up drinking the waters; and all these external effects prove salutary. That oedematous swelling is mentioned by ancient authors. Gouty complaints are in general more successfully removed by abundant urine, than by copious alvine evacuations.

The best confirmation of the efficacy of our waters in gouty disorders, and the best description of a complete crisis I can give, is certainly my own case: I was born in 1770, counting, on the fatherly side, four gouty generations. When thirty-five years old, I began to feel this inheritance, by a severe fit of podagra, which lasted a fortnight, after which my foot remained a long time weak and tender, but without any other ailment. A few weeks, sometimes many months, elapsed, without any attack. In 1822, the podagra disappeared suddenly on the third day, and produced the most alarming symptoms: cough, dyspnaea, sleeplessness, intolerable tickling of the throat; copious, puriform and acid expectoration, rapid decay, cadaverous complexion, in short, all the fore-runners of a tracheal consumption. Leeches, guaiac, Plummer's powders, and particularly, goat's-milk, restored me, but I never lost a painful sensation of stricture in the trachea, so that the air I breathed seemed to pass over an ulcerated surface, and my voice, like a good hygrometer, following the atmospheric variations, was extinct in damp weather, and returned when dry. A little before my departure from Vienna, in April 1826, the same symptoms returned, but with less general weakness and emaciation than formerly. In spite of the alarming state of my lungs and trachea, which counter-indicated the use of the waters, and attending merely to the arthritic principle, I began to drink, on the 17th of May. On the fourth day, I

felt a vertigo, lost my appetite, was unable to stand upon my legs, my eyes were sparkling, my cheeks burning, and I had almost apoplectic feelings. These violent symptoms lasted only two days, after which I continued, during six weeks, to drink seven beakers of Neubrunn, beyond which I could never go. I was very little purged, but the excretion of a fetid and oily urine lasted as long as the use of the water. Gradually all my complaints disappeared, and I was fortunate enough to get completely rid of a large herpetic eruption on the neck, which had annoyed me beyond expression during six years, and had resisted a variety of remedies, and even sulfureous fumigations. My health has been since and is still (1835) perfect.

Such a complete and radical cure, operated in so short a time, is not a daily occurrence, and inveterate gouty cases require in general the repetition of the treatment.

Piles, fluent or blind, being oftener a concomitant symptom than a primary disease, it is nearly impossible to give fixed precepts about the use of our waters in hemorrhoïdal cases, which must be examined and weighed in their totality, before we can decide how far Carlsbad may be useful or hurtful. I have seen a few patients where the great abundance of flux obliged me to send them to other mineral waters, acting with less energy on the vascular system. On the other side, I have observed a still greater number of cases of blind piles, where the bursting

of the hemorrhoïdal vessels and a new flux have relieved painful symptoms of head-ach and general plethora.

In chlorotic disorders and menstrual derangements, the good effects of the Carlsbad waters are less to be expected from the very small quantity of iron-oxyd which they contain, than from their desobstruent quality and their manifest power of accelerating circulation and vivifying the complexion. The same is to be said of leucorrhea, in the treatment of which we must carefully distinguish whether it proceeds from obstruction of the abdominal organs, or from mere debility. The first class can be essentially improved at Carlsbad; the second requires in general other more chalybeate and gaseous waters, such as Franzensbrunn and the *Ferdinand's wells* at Marienbad. — During pregnancy and during menstruation, drinking must be interrupted; but there may be cases of very scanty monthly period, during which it may be recommended with success.

We see every year, amongst the indigent patients admitted in the St. Bernard's Hospital, a few individuals, who, after having worked in the different looking-glasses manufactures of Bohemia, Nuremberg, etc., are unable to continue their profession, on account of a shaking of the whole frame or of some limbs, brought on by the influence of quick-silver or lead. The physician attending that hospital, has assured me repeatedly that the greatest number of them are cured or relieved by the internal use of

the waters and by bathing. Though such diseases occur rarely in other classes of people, I remember to have treated with success the proprietor of lead-manufactures, and a celebrated painter, affected with numbness of the hand, produced by metallic influences. David Becher quotes some cases, where disorders occasioned by arsenic were cured or relieved at Carlsbad.

I have attended successfully many patients, who had laboured under the yellow fever. dysentery, cholera, intermittent fevers, acute and chronic disorders of the liver and spleen at Antigua, Batavia, the Mauritius, Rio de Janeiro, Calcutta, etc. The symptoms which brought them to Carlsbad were abdominal indurations, morbid complexion, herpetic eruptions, dyspepsy, hypocondriasis, etc., which, in spite of their various geographical origin, did in no respect differ collectively from those of the patients we see every year, coming from all parts of Europe.

REFUTATION

OF

SOME ERRONEOUS NOTIONS

CONCERNING CARLSBAD.

Some hypocondriacal patients are inclined to believe, when they see the Sprudel-stones, and various incrustated toys exposed for sale, that such incrustations might equally be formed in their inside. That old fancy was already refuted, in the beginning of the eighteenth century, by Frederick Hoffmann, and later by Springsfeld, Becher and others. Such patients have in general a singular propensity to spread erroneous notions, and to impart to others their own anxiety; so that every one is to be pitied, who, listening to his fellow-sufferers, is not guided by an enlightened and steady adviser. The anxiety caused by the apprehension of intestinal incrustations, should yield to the following observations:

The human frame, endowed with a power of reaction, cannot be compared to a glass or earthen vessel, nor to any cavities of inanimate bodies; the physiological processes, which dissolve, elaborate and assimilate substances introduced in the alimentary tube, differ entirely from the chemical and physical operations taking place upon inorganic bodies; a patient, drinking, in one morning, twelve beakers of mineral water, swallows scarcely eighteen grains of their fixed parts; and animal substances, immerged in the Sprudel, take no incrustation, except when, like eggs and craw-fish, they are covered with a calcareous envelop.

Many patients, arriving here with the idea that the waters can attack their teeth, rub them, after each goblet, with a crust of bread, or with sage leaves. In 1826, I placed human teeth in the Sprudel, during a week, others during a fortnight. They were more or less incrustated, according to the length of their immersion, but, in removing the sediment, I found them perfectly white and sound. Teeth, covered with a very thin and weak enamel, though I never saw such accident, might perhaps be split, if the water was drunk as hot as it springs from the Sprudel (60° R. or 168° F.), but every one lets it cool, so that it is seldom swallowed warmer than 45° R. or 135° F. When the water touches the nerve, it excites sometimes pain in decayed or worn out teeth. A little milk, added to the water, blunts that effect. In general, patients with bad teeth and spongy gums,

will do well to have their mouth put in order before the use of the waters, and to continue, during it, the usual attentions commanded by cleanliness. Sage and bread are at least useless.

It is generally ascertained that our waters dissolve the callus of fractured bones, and that opinion seems to have no other support than a single fact, faithfully related, but falsely interpreted. It has, however, produced as much sensation as if confirmed by daily experience. Gentlemen of the army, in the Austrian as well as in foreign services, feeling themselves more particularly interested in it, admit as an axiom, that: *Whoever does not wish to experience the disjunction of a fractured bone, must not drink the Carlsbad waters.* That erroneous opinion preventing people who have met with such accidents, from drinking the waters, in cases where they are evidently indicated, I shall relate the observation published by the celebrated Dr. Hufeland, which has alone given rise to this general belief (Hufeland's *Journal der praktischen Heilkunde*, Bd. XLIII. 4. Stück. p. 135. 1816).

"On the 12th of June 1716, Mr. de F., when tra-
"velling, broke his arm. Fifteen days afterwards,
"the fracture being sufficiently solid, the patient, to
"whom, before the accident, Carlsbad had been or-
"dered for abdominal complaints, was sent there by
"his physician. On his arrival, the callous matter
"was found regularly spread on the fracture; a pro-
"per bandage was applied by a skilful surgeon, Dr.

"Brieske, physician to field-marshall Blücher; and "Dr. Mitterbacher, of Carlsbad, to whom the patient "was recommanded, allowed him, without hesitation, "to begin the cure, on the 4th of July. He drank at "first moderately, increasing gradually to fourteen "beakers a day. The water operated much more "upon the kidneys than upon the bowels, and pro- "duced now and then shooting pains in the fracture. "The medical attendants observed very soon that the "callus was turning soft; the patient however con- "tinued drinking; the shooting pains increased till; "to their utmost surprize, they found, on the 9th of "July (6th day of the water treatment) the callus "completely gone and the fractured parts moveable. "The waters were then discontinued, and, with the "help of a proper bandage, the local accident was "completely healed in a few weeks. This is a most "remarkable case. What prodigious activity must not "that water have! What better proof do we want "of its resolving quality, and of its power to destroy "the reproductive quality of the lymph? Can we "longer wonder that such a water dissolves more "efficaciously than any other known remedy, the "obstructions and coagulations of the bowels?"

H — d.

The crystals of Carlsbad salt having been dis- covered, with the help of a strong microscope, in the perspiration of water-drinkers, why should not that salt have penetrated the bones of the above-mentioned

patient, as well as madder gives a red colour to those of a cock or of a dog, fed some time upon that plant?

Dr. Hufeland, on the testimony of two unquestionable witnesses, saw with reason, in Mr. de F.'s case, a new proof of the power of our waters to dissolve intestinal obstructions, but the conclusion drawn by others from his report: that the *Carlsbad waters soften and disjoin old fractures*, was unwarranted and inconsiderate. In this case, between the fracture, which took place on the 12th of June, and the Carlsbad cure, commenced on the 4th of July, the interval was only two and twenty days, during which time no hard and solid callus can be formed. I never heard any similar case told at Carlsbad; none is on record; David Becher himself, to whose attention nothing escaped, mentions no accident of that sort, though in such a crowd of invalids, old fractured bones must be frequent; and even, since Mr. de F.'s case has been related by Dr. Hufeland, who did not draw the same conclusion from it as his readers have done, no practitioner, as far as I know, has made any similar observation.

We have seen that the constituent parts of our various springs are perfectly identic; that they only differ by their temperature and by more or less carbonic acid, which is always in inverted ratio to the degree of heat. In spite of the identity of their fixed ingredients, the expressions of *strong* and *mild* fountains are in general used at Carlsbad, instead

of *warmer* or *cooler;* innumerable patients attribute to them different effects, and are afraid to loose time so long as they drink what they call the *mild* or *weak* waters. Those erroneous opinions are easily rectified at Carlsbad by their medical adviser; but they may be attended with the most serious consequences, if foreign physicians, taking for granted that we have weaker and harmless springs, send us patients, who very soon experience that neither one spring nor the other can agree with them. Certain individuals have, no doubt, a kind of elective attraction for one source or for the other, and obtain from that spring all sorts of good effects, whilst another one will act perhaps differently. Such individualities must be attended to and particularly respected, but the closest attention to the effects of our various wells is insufficient for classing them *a priori,* according to the diseases in which they prove more or less useful. The great question, in sending patients to Carlsbad, is not to decide which source they should drink, but whether our waters are indicated or not. I have treated at full length this important subject, in the *Almanach*, for 1832, ch. III.

I have met with a few ignorant hypocondriacal patients, afraid of the green stuff surrounding our wells *(Confervae thermales)*, because they suppose it to be *vert-de-gris*. We hope that such a fancy never can perplex any one who has read, in the present opuscule, the interesting observations of Mr. Corda upon those remarkable animal creatures.

WATER AND STEAM-BATHS.

We have seen that the fame of Carlsbad began with the use of water-baths; that steam-baths are the third period of our medical history; and that the superiority of our present institutions is founded upon the junction of our therapeutic resources, though drinking remains the most important part of the treatment. It would be almost impossible to describe the various cases in which water-baths prove useful, but we may say in general that they assist powerfully the internal cure, in a variety of rheumatic, gouty and herpetic cases; that they often facilitate the passage of biliary and urinary concretions, and that they are more efficacious, and less productive of congestions, when the secretory and excretory action of the water on the bowels and kidneys has already commenced.

Our steam-baths being a new institution, I shall give summarily the result of my observations during the seven years of their existence.

The vapour, rising so copiously from our wells, had never been examined before. We are indebted for its first analysis to Mr. Nentwich, apothecary at Carlsbad, who undertook it, at my request, before they were opened to the public.

"The vapour of the Hygiaea-spring, taken in the "apparatus standing the nearest of the square channel, "through which it rises, gave, on the 20th of De- "cember 1826, with an external atmospheric tempe- "rature of + 5 R., the following result:

1. "The temperature within the closed apparatus was "+ 36 R.
2. "100 parts of vapour, + 36° R., cooled to + "5° R., were reduced to 83,333 parts of space, "and that gaz was composed of 4,183 parts of "carbonic acid gaz and of 79,150 parts of atmo- "spheric air.
3. "The water, under the form of drops, is, with "the exception of a little carbonic acid gaz, en- "tirely free from saline parts."

We see, therefore, that the Carlsbad vapour is composed of atmospheric air, carbonic acid gaz and aqueous vapour.

One might be inclined to question the powerful effects of such a simple mixture, entirely free from fixed particles; that power, however, will be more

easily felt than understood, by any one who, exposing his hand or his foot to this natural heat, compares his sensation with what the same limbs will feel, when exposed to the vapour of an artificially heated water. That natural, *telluric*, heat is mild, penetrating and comfortable, even to 36° — 40° R., which can be considered as the middle temperature of those steam-baths, supported by some patients even to 44 — 46° R., whilst the vapour of common water, heated in a kettle, is sharp, burning and intolerable in a few moments, under far inferior temperature. We have, as already mentioned, general and partial steam-baths, and if the patient takes only a half-bath, that is to say, if he sits in the box up to the pit of the stomach, he bears a few degrees of heat more than in a whole bath. The head is never exposed to the vapour, which on account of the carbonic acid gas, would very soon produce dangerous effects.

Few individuals support a whole steam-bath above twenty minutes, but a half-bath longer. Some patients, labouring under the *tic douloureux*, after having tried innumerable remedies, and even surgical operations, have been, if not radically cured, at least essentially relieved. The steam-baths have proved useful in some cases of deafness; and if such patients cannot support the stream of the vapour-douche in the inside of the ear, it must be directed in the neighbouring parts of that organ. In rheumatism, lumbago, sciatic, stiffness of the joints, contractions

of muscles, the vapour offers a precious remedy, but should never be used, when attended with febrile symptoms. In herpetic eruptions, in the hepatic spots, they are useful, conjointly with the internal cure, but certainly far less than the sulfureous fumigations, which produce a much more complete desquammation of the skin than the thermal vapour.



REGIMEN.

WITHOUT submitting our invalids to useless privations and painful abstinences, a regular regimen must, however, accompany the use of a mineral water, which excites so manifestly the vascular system, and the action of the bowels, kidneys and skin. The few rules of our dietetic code are seldom transgressed with impunity.

In enumerating our various provisions, I remarked (p. 24) that our restaurateurs never present any dish incompatible with the use of the waters, and that dangerous dainties are not to be found at Carlsbad.

The interval of an hour is necessary between the last beaker and the breakfast, and, in order to promote the digestion of the water, patients, stout enough to continue the walk they have taken at the wells, should protract it about an hour longer, before their

breakfast, which many, when the weather permits it, take in open air.

Most people drink coffee or chocolate. Without reprobating these two articles, I shall only observe that coffee aggravates hepatic disorders, attended with a disposition to inflammation, particularly when the presence of gall-stones excites pain or irritation; it produces in the liver a burning and pungent sensation, which often disappears as soon as patients adopt some milder mode of breakfasting, such as soup, an infusion of balm, or other harmless beverage. Coffee, in one word, should never be allowed to invalids, whose abdominal organs give such signs of inflammation or sensibility to the touch, as to require leeches, or any other part of the antiphlogistic treatment, so often necessary with our patients.

Chocolate does not produce the same irritative effects as coffee, so remarkable for the subtility of its aromatic principles, and still less a plain decoction of cocoa; but few people digest well and relish chocolate for any length of time, as they do coffee or tea.

Tea has been in general proscribed in most German watering-places, at least in those of Bohemia. Not being a national beverage, physicians and patients have so seldom a personal experience of it, that in the numberless works published on mineral waters, so minute on other articles of diet, nothing or very little is said about tea. That infusion having been found incompatible with the use of more essentially

chalybeate waters, that incompatibility has been, without any examination, extended to ours. Submitted to exact calculation, I find that six goblets of water contain the $^{55}/_{1000}$th part of one grain of oxydule of iron, that is to say almost a nullity. Let us suppose that a patient drinks twelve or even eighteen goblets, what influence can such a quantity of iron have upon two or three cups of tea, taken an hour after the waters, and still less, when taken in the evening?

Innumerable visitors, coming from countries where tea is as common a beverage (England, Russia, Poland, Holland) as coffee in Germany and France, many would find it excessively hard, as they did formerly at Carlsbad, to give up their habitual mode of breakfasting. The fact is that tea does not excite the blood-vessels, as much as coffee; that it acts more directly on the nervous system, and keeps awake those who are not accustomed to it, or who take it immoderately strong; that such effects are never felt by people who drink it daily; that those who never drank it, should not begin at Carlsbad; but that those who are accustomed to that beverage, have no reason to discontinue it during the cure; and that black tea is far preferable to the more acerb and astringent green sorts.

Concerning breakfast, we are daily asked whether butter can agree with the internal use of the waters. Being exquisite in our valley, I never found

it hurtful in moderate quantity, spread upon fine white bread, which is of the best sort at Carlsbad.

Strawberries are so plentiful, and last so long, that patients are tempted to eat them. Their acidity, disturbing the action of our alkaline waters, deranges the bowels, and occasions colic or diarrhea, whilst, on the other hand, the innumerable seeds of that fruit, by their astringent quality, produce sometimes costiveness. Every sort of raw fruit must be interdicted, but *compotes* are harmless.

Our digestive powers being sufficiently employed with the elaboration of the water and of a moderate breakfast, warm and cold meat *(déjeûners à la fourchette)* are inadmissible.

The dinner hour varies from one to three o'clock. The bill of fare is exactly regulated in eating-houses. Those who bring their own cook, must follow the instructions of their physician about forbidden or allowed dishes.

Bohemian, Hungarian, Austrian and various foreign wines can be had at Carlsbad; but their choice depends much more upon their genuineness than upon their name; and whatever sort is adopted, great moderation is indispensable. The necessity of a quiet sleep, and of going the next day to the wells with an empty stomach, does not admit of a regular supper. Every patient, according to his own predilection, should content himself with tea, chocolate, or soup.

It is imprudent to take ices, under the influence of a water which promotes perspiration.

The principal conditions to be observed, besides the above dietetic precepts, are temperance, gentle exercise, no serious occupations, no profound reading, and, above all, tranquillity of mind. No where can be better applied than at Carlsbad, the well-known inscription, placed at the entrance of the Antonin's Baths: *Curarum vacuus adeas hoc templum, ut morborum vacuus abire queas. Non curatur qui curat.*

OBSERVATIONS

ON THE

MICROSCOPIC ANIMALCULES ABOUT THE HOT SPRINGS OF CARLSBAD,

BY

MR. **A. J. C. CORDA**, OF PRAGUE.

(Translated from the German manuscript.)

WHEN the celebrated Dane, Otho Frederick Müller, discovered, in 1786, the *Vibrio paxillifer*, and described the *Conferva pectinalis*, it was for the cultivators of natural history a new series of beings, whose form and life appeared so problematic, that some time elapsed before they knew to what organic kingdom they belonged. Müller had already classed the *Vibrio paxillifer* among animals, and the *Conferva pectinalis* among plants. But this sagacious observer ranged them very soon amongst the infusory animalcules. Mr. Bory de St. Vincent (Dict. class.

d'histoire naturelle, art. *Arthrodiées*) and Mr. Nitzsch (*Beiträge zur Infusorienkunde.* Halle, 1817) threw later some light on their nature. The first placed them between the two organic kingdoms, and the second acknowledged their animality. After them, the celebrated traveller in Africa and Asia, Mr. Ehrenberg, author of important discoveries, ranged the animalcules, of which we are treating, among the *cuirassed Infusoria with feet alternately moving in and out;* and about the same time several naturalists, endowed with less perseverance and sagacity, and without recurring to analogy nor to anatomy, placed them in the vegetable kingdom. Professor Agardh, of Lund in Sweden, formed with them a family of plants, which he called *Diatomeae*, and ranged them in the lowest cathegory of the Algs. He was followed by MM. Lyngbye, Turpin, Meyen, Kützing and others. Greville, Meyen and Turpin gave the best representations of them; Kützing described them in his *Synopsis Diatomearum* (as wretched a performance as the drawings representing these animalcules), without possessing the means required for similar investigations, nor the knowledge of their remarkable structure.

Though incomplete, this short historical sketch will suffice, I hope, for the intelligence of this Memoir, in which nothing farther is intended than the natural history of the thermal animalcules, which I observed last summer (1834), about the hot springs of Carlsbad.

Springsfeld, in 1752, and Mr. Scherer, of Vienna, in 1787, were the first who wrote upon the *green matter* (materia viridis) of the hot waters of Carlsbad, and, after them, the celebrated algologue A. C. Agardh (*Almanach de Carlsbad*, for 1834, ch. IV.) described particularly the *Oscillatoriae* and a few *Frustuliae;* he repeated the same description in his *Conspectus Diatomearum*, of which we find again the drawings, probably taken from some entirely dried and decayed specimens, in his *Icones Algar. Europ.* Tab. 1—2.

HABITATION OF THE ANIMALCULES.

An attentive observer will scarcely pass near the springs of Carlsbad (or any other hot mineral water) without remarking upon the wood and stones, which surround the wells, a limy and gelatinous green stuff, thicker or thiner, and often lamellous. Plenty of it is to be seen upon the boards, stones and pipes, which surround the hot wells, at their outlets, in short, in every place where the hot water runs or transudes. Carefully examined, that unctuous and gelatinous substance is composed of myriads of elegantly and symmetrically formed beings, most of them belonging to the animal kingdom; and their forms, their mode of life and of propagation can only excite the highest degree of astonishment.

In the middle of that chaos of limy, often stinking and putrid substances, apparently deprived of life, the eye, powerfully armed, discovers ideal proportions and symmetrical forms, which the most fecond imagination of an arabesque painter could not create. These myriads of beings are however animated, presenting, under the same type, an infinite variety of forms; these corpuscules, whose size is frequently the 0,000015, viz: the 15millionth part of a Paris inch, and seldom more than the 9thousandth part, are endowed with organs, simple indeed, if we compare them with animals of superior orders, but complicated, proportionally to their own body. They move, give signs of feelings of self-preservation and propagation, possess irritability, and often even the means of appropriating to themselves extraneous substances, foreign to their nature.

The fluid, in which they live, is originally water, in contact with inorganic matter, with heat, and with the remains of organized bodies, the dissolution of which forms a sort of animal lime. Several naturalists have taken this unctuous, transparent and gelatinous substance for parts or organs of these beings, which they classed among plants. A more attentive investigation of the mucous inferior layer of *Oscillatoriae* (Pl. VI.) shows, however, that the gelatinous mass is composed of the deceased animalcules, in which we can distinguish the various degrees of their dissolution, their fibrous remains, and their transition to a gelatinous form. This inferior

mucous layer (the *stratum mucosum* of botanists), does not constitute the organs of the animalcules, though the latter cannot live and propagate themselves but in the middle of them. Nevertheless, I have often drawn them out of the gelatinous mass, in order to place them in river-water, where they lived a long time, without any appearance of diseased alteration.

Water, a solid substance, heat, a beginning putrefaction, appear indispensable to the production and propagation of the animalcules; and such conditions are in fact always united. Without moisture, they never live; a solid substance must offer a basis to moisture, and, according to physical laws, the contact of the one with the other generates heat, and only by the simultaneous action of moisture and heat can putrefaction take place.

Though often found in the froth of rivulets and rivers, they have not been generated there, but floated off by the stream. These animalcules living never in thermal water, they are only to be seen at a few inches distance from the wells, and when kept in glasses or pots, they soon retreat towards the sides of the vessel. They are never found in the limpid water of a cold spring, river or well, nor of a hot spring, even if the water has reposed for hours and days, so that we can consider as erroneous, and suggested by a fondness for marvellous things, the popular opinion, so generally spread, that we swallow with common water innumerable

animalcules. Sight and smell would disgust any one to drink a water full of these living creatures, which is always dirty and coloured

In order to investigate these animal aggregations, the green gelatinous matter is collected in a glass, with a wide orifice, into which we pour a little of the water in which they lived, or, if not to be had, river-water.

The microscope, intended for these investigations, must show the magnified objects clear and distinct. MM. Pistor and Schiek, in Berlin, Plössl, in Vienna, and Chevalier, in Paris, make the best instruments, which magnify 1000—3000 times. Those which magnify only 5—600 times, are unfit for such researches. A particle of the green thermal substance, of the size of a pin's head, is placed upon the object-glass, and torn between two sharp instruments, or, if wanting, with pins; and the green fragments are moistened with a small drop of water. The observation begins with magnifying 100—200 times, in order to detect the most distinct forms. Has an animalcule been discovered, it must rest some time under the instrument. The observation must be repeated with a magnification of 4—600; and after having acquired some skill in the mode of magnifying, we continue the intended investigation.

After having acquired by numerous trials a certain dexterity, the anatomy of the animalcules takes place in two different ways. The first is plain and easy: A flat bit of glass, as thin as paper, very pure and

transparent, is placed over the animalcules, which are flattened by the pressure of the glass, so long as the observation lasts. The second, requiring still more dexterity, takes place by separating the larger species, with a very sharp and cutting needle, but it requires an extremely good eye and patience.

Perseverance, so necessary in all sorts of researches, is indispensable in microscopic observations, which must be often repeated and varied; but that trouble is amply rewarded, and the pleasure felt by the investigator, who discovers new forms, so beautiful, so surprizing and unexpected, is beyond description.

FORM AND ORGANS.

According to the organisation of these animalcules, we can divide them into two classes, subdivided into six families, viz. the *Naviculae*, the *Cosmaria, Euastra, Fragilariae, Closteria* and *Arthrodiae*. The three first families have a brittle tegument, the three others a flexible one; but, in order to recognize exactly the form of these creatures, it is necessary to describe each of the organs which compose them.

The external tegument *(epidermis)* of these animalcules is of two species. It is a siliceous, transparent and vitreous shell, called *cuirass* (lorica).

(Pl. I. II. IV. V.); or, the cuirass wanting, the epidermis is naked (Pl. III. et VI.).

The cuirass, answering, in the greatest number of animalcules, to the valve of muscles, is composed of two siliceous and transparent parts, surrounding the animal. The univalve cuirass is a leaf rolled on itself (Fig. 5—17., 38—17), the edges of which are confounded together, so that they never form, except a few small openings, a valve surrounding entirely the animalcule. That cuirass appears smooth, for instance, in the *Frustulia appendiculata.* Ag. (Pl. I. fig. 12—13. a.), or striped, as in the *Navicula costata* (Pl. I. fig. 9—11.), where the stripes are distributed like rays, setting from an ombilic, to be found in one of the middle ribs of the cuirass (fig. 9. a.); or merely ribbed; or provided with strong and elevated ribs, such as in the *Navicula ciliata* (Pl. I. fig. 5. a.), where the ribs are besides covered with fine hair.

Towards the lower parts, the cuirass forms in the *Naviculae* and *Frustuliae* a flat surface, generally quadrangular (parallelogram), called *pedal surface* (fig. 8. e., fig. 13. b.), to which two animalcules are always adhering.

In the *Diatomeae,* for ex. in the *Diatoma fenestratum* (Pl. IV. fig. 38.), the cuirass is flattened on the edges, and cut in half circles, whilst, where the animalcules are adhering, it forms a narrow surface of reunion (fig. 38. b.). The form of this surface corresponds always with that of the cuirass, viz. it

is narrow in the flat cuirass, and triangular in the triangular cuirass of the *Desmidium Swartzii* (Pl. IV. fig. 44.). The form of the bivalve cuirass is always analogous to that of the animalcule. *Surirellae* (for ex. the *Surirella Venus* (fig. 1—4.) have, according to the length of the animalcule, an open cuirass, each valve of which is like a pot, the one included in the other, in a very peculiar manner, forming a sort of inge (fig. 4. b.), nearly similar to a round snuff-box. Their edges, besides, are supplied with rounded and radiated elevations (fig. 4. A.), between which are seen furrows of the same size (fig. 4. B.). Though different, the bivalve cuirass of the *Closteria* has an analogous form. Each valve (fig. 61. A. A.) forms cornucopiae, the uniting point of which is seen in the middle of the animalcule, where the sexual openings (fig. 61. c.) are to be found. No inge is to be seen, but the two thin edges of the valves (fig. 62. d.) are placed immediately one upon the other. This cuirass is open at each point of a valvule, its being the place where we see the opening which I consider as the mouth (fig. 61. 63. b. b. 64. 65. a. a.)

In the *Pleurosicyos myriopodus*, the cuirass has two valves, of the same form as in the *Closteria*. It is, besides, octangular (fig. 69.), and on each side of an angle, 8—12 pedal holes (fig. 68. b.) are seen.

The *Cosmaria* must be considered as double animals, forming together a double cuirass, and each separately a single one.

The *Cosmarium deltoïdes* (fig. 18—19) has two warty cuirasses, united on their broad surface, the openings of which communicate only with the surface uniting both animalcules. The *Cosmarium bipes* (fig. 20) has a cuirass of the same form, and appears however always split on its external surface, the more so as, during fecondation, this fissure (fig. 20. a. a) opens itself. In the middle of the lines which unite the two cuirasses of an animalcule, we see a nearly quadrangular opening of the uniting points; which opening is the mouth. On both sides of it are two openings (fig. 20. b.), through which the animalcule pushes a scarcely perceptible bladder, by means of which it sticks to the inside of the glass. I name therefore these openings *pedal holes*.

In the *Colpopelta viridis* (fig. 28) we see, on the inferior surface of the univalve cuirass two openings (a), placed opposite one another, which must be considered as those of the alimentary tube.

I name *coat* the epidermis which surrounds entirely the animalcule; and, as far as I could observe it in some larger species of *Naviculae*, inhabitants of rivers, that coat is, at the same time, the pedal organ, which, under a vesicular form, passes through the valvular openings, and by means of these feet the animalcule adheres to the glass.

In the cuirassed animalcules (such as the various species of *Surirella, Navicula, Closterium* and *Cosmarium*), the epidermis clothes the whole internal surface of the cuirass, and lines it like a bag.

In the *Surirella Venus* (Pl. I. fig. 4.) the epidermis possesses manifestly muscular strength, and when the muscular bag opens itself, it opens the cuirass, and by its contraction, it closes entirely the valves.

In the *Cosmarium deltoïdes* (fig. 19.) the two valves of the cuirass separate themselves by the muscular strength of both bladders (a.), passing through the holes of the cuirass, and uniting themselves again, as soon as the bladders are drawn back. In the *Cosmarium sinuosum* (fig. 21), *stellinum* (fig. 22.), *truncatum* (fig. 23 — 24), as well as in the *Closteria* (Pl. V.), I have seen, in the very moment when the animalcule was dying under violent galvanic strokes, the coat falling off from the cuirass, and contracting itself partly. I have already said that I shall call *naked* the animalcules of this series, viz. the *Euastra, Pediastra* and *Stauridia* (Pl. III), the *Scenodesmi* (Pl. IV. fig. 49 — 53), the *Sphaerozosmi* (fig. 39), the *Ophiothrix* (fig. 83 — 84), the *Sphaerodesmi* (fig. 86 — 90), and the *Oscillatoriae* (fig. 71 — 81.). All these genera stand at the lowest degree of the animal scale, and give but weak signs of life.

ORGANS OF MOTION.

Their movement is performed by very simple organs, when in possession of them, or with the whole body.

In describing the cuirass and the coat of these animalcules, I spoke of the feet passing through the holes of the cuirass, and of those which are formed by the elongation and extension of the coat. These feet are easily observed in the *Frustuliae* and *Naviculae* of larger species. The *Pharyngoglossa sygmoïdea* has, above the mouth, a longitudinal fissure (fig. 16. b.), through which the pedal bladder comes out (fig. 16. b. b. b.). A similar bladder is observed in the posterior part of the body, and at the end of the intestinal tube (fig. 16. c.).

In the *Frustulia viridescens* (fig. 17.) larger vesicular feet (b) are easily seen. In the *Scalptrum* (fig. 70.) they are seen (b.) near the extremities of the body upon the angles, where the middle opening is found.

In the *Pleurosicyos myriopodus* (fig. 68) we see several hundreds of such feet (b.); the animalcule being octangular, and each side having 18—20 such feet, consequently upon both sides 40 feet: $40 \times 8 = 320$ are the total number of the animal's feet.

In the *Oscillatoriae,* the *Closteria* and several other genera, I never was able to discover these feet.

The motion of the animalcules is seldom performed by the vesicular feet. The *Frustuliae* and *Naviculae* swim by a slow motion of the whole body; the *Cosmaria* and *Euastra,* by floating; the *Diatomeae,* by moving every one of their limbs; and the *Oscillatoriae* by a vermicular creeping, similar to the motion of earth-worms. *Ophiothrix* derives its name from the serpentine and spiral motion, and from the quickness of this animalcule, comparatively superior to that of all the creatures of this series.

The *Sphaerodesmi* (fig. 85—87.) roll themselves by a floating motion, and rise by a spiral one, by means of which, though slowly, these animalcules ascend from the bottom to the surface of the water, and go down again.

The act of creeping, peculiar to several *Oscillatoriae* seems to be performed by pressure upon neighbouring filaments or other parts. Some of these animalcules are always seen creeping in company under the microscope.

The *Oscillatoria subulata* (fig. 71—72), standing upright, cannot creep with the whole body, but that remarkable creature seems to be constantly employed to its own propagation, considering that the coat of the mother opens itself again, as well as the still younger one (c. d. e.). This last filament in the place where it abandons the opening of the coat, is articulated, as well as the coloured content of the materna filament (d.). These articular nodes are separated by filiform intervals and represent a rosary,

loosing itself in its upper part into the capillary point, which is often very long, and has very thin articulations. When a filament has left by creeping the mother's body (as in fig. 72), this content (b.) forms a point, often similar to a drop, which grows gradually longer, till it acquires the form of an articulated filament; and in this manner the process already described is successively performed.

Other *Oscillatoriae* (such as the *Oscillatoria elegans* Ag. fig. 73—74) creep in turning and bending the pointed extremity of their head (a.), from upwards downwards, or from right to left, as the movement requires.

If, during this movement, filaments or other exiguous bodies present themselves on its way, the animalcule feels them with the point of the head, till it has gone round or over them. Does it meet larger bodies, it adheres to them or ascends over them, but it very soon puts aside the smaller ones, or, as the *Naviculae* do, drives them along with itself.

The *Frustuliae* move in less than a minute, upon a surface of one line. The *Oscillatoriae,* in four and twenty hours, move from one to four inches.

Our *Diatomeae,* found in rivers, are almost motionless; those which inhabit the sea move quicker. Many animalcules of this class move only during the night. I have seen the *Closterium costatum* (fig. 61.) and the *Closterium didymotocum* (fig. 64.) ascend, during that time, from the bottom of a glass cylinder, from 4—30 lines, upon the inside of the glass, whilst,

in day-time, and at the light of a lamp, I could not observe any motion.

Several *Oscillatoriae* creep only during the night and in dark places.

Upon many of them, as well as upon various *Naviculae* and *Frustuliae,* light exercices a manifest influence. When kept in cylindrical glasses, they move towards the lighted side, and abandon the dark one. I avail myself of this circumstance, when I want to catch the finest specimens. When preserved in china vases, filled with water, they reach very soon the surface or the sides of the water, when exposed to light.

In day-time, the *Surirella Venus* closes more its cuirass, which is never seen open but in dead individuals. During the night, and at the weak light of a lamp, I found many of them open, but they closed quickly their valves, when I directed upon them a more intense light.

I have very seldom seen the points of the *Pediastra* bending and moving themselves, and it is equally rare to see the *Closteria* crooked; but these motions were much more frequent in the animalcule, when exposed to galvanic or electric strokes.

ORGANS OF NUTRITION.

The act of nutrition and its organs are objects of difficult observation in this series of animalcules, on account of the impossibility of using the means employed by Mr. Ehrenberg in the investigation of the true *Infusoria*, because the creatures, mentioned in this inquiry, do not admit colouring substances. Analogy alone can assist us, and even very weakly, in these researches.

In the *Surirellae* and *Naviculae* I could not discover any tube running parallel to the body.

We see, however, in the *Surirella Venus* a skin separating itself from one of the points of the coat, in which skin (d. fig. 4.) there is an incision, leading to the content (e). By means of this overture, the animalcule throws out entirely the content; but I never could distinguish upon the coat any opening nor fissure.

The *Naviculae*, according to my classification, include the species of the most ancient genera of *Frustuliae* and *Naviculae;* which, next to the pedal surfaces (fig. 4. 8. e.), found in the axe of the body, are supplied with two openings (d. d.) leading to two empty tubes (f. f.) passing through the whole animal, and, on both opposite extremities, terminated also by two holes, near the smooth pedal surface.

In the *Navicula costata* (fig. 10.) these two openings are found under the flat pedal surface, and

even the truncated extremities of the body (f. f.), placed on the edges of that surface. The foot (b.), resembling a scarcely perceptible wart, is to be seen in the axe of the body, between the two openings (f. f.).

The *Pharyngoglossa* is the only genus of this series, in which the mouth, the alimentary tube and the anus of the animalcule are clearly distinguished. The head (fig. 16. A.) is easely known by the fissure of the cuirass, out of which the superior foot (b. b.) comes. We find under this foot the orifice (a.), in which a stopple is seen (a. a.) moving in and out. From the mouth issues the cylindrical thin gut (f. f.) reaching the back parts of the body and unloading istelf into the orifice of the cuirass, through which the back foot (c. c.) protrudes.

The *Pharyngoglossa* is the only animalcule of that series, in which I could distinctly see an ingestion of substance. He pushed the stopple (fig. 16. a. ^{2}) much forward, with the help of a very fine and scarcely visible ligament, out of the opening of the intestinal tube, which by analogy we shall call *the mouth* (a), in consequence of which I saw an empty space between the stople (a. ^{2}) and the mouth (a. ^{1}). Water, saturated with organic atoms, penetrated of course this empty space, and dragged these atoms into it. Soon after, the second introduction of the stopple (a. ^{2}) stuffed the mouth (a. ^{1}) and led into it, at the same time, both the water and the substances with which it was impregnated.

The various species of *Cosmaria* seem to receive substances through the hole (fig. 20. c.), which is constantly open. The *Colpopelta* has upon the inferior surface, at both extremities of the body, a longitudinal tube (fig. 28. a.), which seems to unite both openings.

In the *Closteria* we find upon the point of both sides of the cuirass, perforations which I consider as mouths.

In the *Closterium Lunula* Nitzsch (fig. 56 — 58.) this mouth (a.) is very easily found; it leads to a very short, and sometimes not well marked tube (b.). Moreover, we observe this orifice in the *Closterium caudatum, acuminatum, didymotocum* and *spirale* (fig. 59 — 67.). In the *Closterium costatum* each horned extremity of the cuirass is truncated, and a larger, blunt and more opened mouth (fig. 61. 63. b. b.) comes out of its edges. Between this orifice and the content of the animalcule, through which the intestinal tube passes, the *Closteria* present a peculiar organ, which I name *rotatory bladder,* without knowing its functions. Some naturalists have taken those bladders for feet; but feet, entirely surrounded with a cuirass, and without any communication with the outside, would answer very ill the purpose of moving.

This spherical organ is always found under the orifice, and in the *Closterium Lunula* under the mouth (fig. 58. b.) and the intestinal tube. That bladder is transparent, round, circumscribed in itself (fig. 58. c. 62 — 63. a. 73. c. 65. c.), the number of which

remains always almost the same. Diving downwards and upwards, they move in circular lines, as molecules do. In the *Closterium Lunula*, several are often found; in the *Closterium costatum*, never more than one; in the *Closterium didymotocum* we see two twin globules (fig. 65. e.), forming only one body, the union of which is still visible.

In a series of species of this genus, I have seen globules without apparent bladder, moving freely towards the empty point of the valvules: which motion is distinctly seen in the *Closterium acuminatum* (fig. 59. e.). The vesicle surrounds the coat contiguous to the cuirass, and that coat cannot be separated from it but by galvanic strokes.

When the *Closteria* die, these animalcules retreat downwards, and present nothing more than a scarcely visible spot. In squeezing them under a flat and very thin bit of glass, I sometimes succeeded in obtaining them single, and then they appeared to me quite spherical, without the least mark of adhesion.

In the *Closterium Lunula* and *didymotocum*, we discover under the rotatory bladder, and above the first, the marks of an intestinal tube in right line (e. e.), surrounded with the green substance, which fills the animalcules. In spite of the finest instruments and innumerable trials, I never succeeded in separating this tube, because the green substance, half liquid, mixed with large oily drops, cover the whole, and baffles every direct observation.

Speaking of the intestines, we must mention the

coloured substance of these animalcules, which, surrounded with the coat, colours them in a particular manner. These substances appear to me in general gelatinous, half liquid, homogeneous, containing drops of oil or of fat, and very small solid grains.

In the *Surirella Venus*, this substance forms a brown or green mass (fig. 4. e.), heaped in the middle of the animalcule. In the *Naviculae*, the *Frastuliae*, and in some of the *Diatomeae*, this mass forms a small thin leaf, coloured, bent in its edges downwards, such as in the *Frustulia appendiculata*, (Pl. I. fig. 13. c. c.) which, when the animalcule dies, is irregularly dissolved. The genus *Scalptrum* and some species of non-described *Naviculae*, can expell, without dying, the coloured content, through the opening found on the surface of the belly (Pl. V. fig. 70. b.) and these animalcules seem to possess the faculty of reproducing the content.

This content is equally seen in the *Diatomeae* and *Fragilariae*, and the two extremities of the body alone, being empty, are transparent. In the articulations of the *Diatoma fenestratum*, it merely consits in pale globules, always single and of various size (fig. 38.).

The genus *Closterium*, and those which are related to it, are on each side filled with a green substance, similar, though chemically different, to the chlorophylle of leaves: which substance covers large drops of a yellow oil (fig. 57. h. fig. 64. f.). This substance is here, as well as in the *Frustuliae*, intercepted in the middle of the body, and consequently divided

into two equal parts. In the *Closterium Lunula* (fig. 57.), it is partly separated by sharp teeth; in other species, such as the *Closterium spirale* (fig. 67. h.), it appears like a green spiral ribbond in the cavity of the coat.

In the *Pediastra, Euastra, Stauridia, Cosmaria* and in the *Colpopelta,* the green substance fills entirely the two articulated parts of the animalcule, and hides often from one to four drops of oil (fig. 30. 31. 35. a. a.); but, near these drops, small solid and dark grains (b. b.) are seen swimming, and in a continual oscillatory motion, like the corpuscules of the rotatory vesicle of the *Closteria.* The same takes place in the *Scenodesmi, Echinellae, Sphaerodesmi,* etc.

In the *Oscillatoriae* the content consists in small disks, placed close one another, having only a small cavity, for ex. in the *Oscillatoria labyrinthiformis* (Pl. VI. fig. 76. a.).

ORGANS OF PROPAGATION.

The organs of generation are in this series very obscure and problematic. I do not know them. I shall however hazard a few observations, perhaps of some importance, which may he brought under this head, as long at least as we shall not be able to point out these organs more positively.

The *Naviculae* and *Frustuliae* place themselves, two and two on the side of their pedal surface, and remain sometimes whole days in that position, and separate themselves again. I have seen a pair of the *Frustulia agrestis* (fig. 14. a.) united in this way, go slowly asunder, and remarked that, in spite of that apparent separation, both individuals were joined by two very narrow tubes (fig. 14. b. c.). And in magnifying them still more, I observed that these tubes passed through the cuirass and communicated with the brown content. I saw also upon the orifice of the tubes an areola forming itself by a thicker and darker content. They remained united about an hour, after which the separation took place as follows: The tube (c.) drew back in the animalcule (fig. 14. b.), and the tube (d.) towards (f.). Soon afterwards, having been able to observe the animalcule (f.) from downwards, or from the pedal surface, I saw (fig. 15.) in the middle line upon (d.) a larger opening, and upon (c.) a smaller one. In the last, the tube (fig. 14. b. d.) had drawn back; and the tube of the other animalcule entered into the first. In looking sidewise, I discovered, though rather indistinctly, both openings (d. c.).

Under the opening of the mouth, we find in the *Pharyngoglossa,* under the middle line and under the alimentary tube, a small round wart (fig. 16. d. and 16. b. d.), perforated in the middle, of a very doubtful function, and which, considering its position, I bring under this head.

In the *Cosmaria*, we find in each half of the animalcule (fig. 18. and 19.) a bladder in the axe (d.), and two other lateral ones (c. c.) of a darker colour, containing innumerable molecules, constantly turning and moving. I said above that the *Cosmaria* were to be considered as double animalcules, united during their whole life. In the *Cosmarium deltoïdes* (fig. 18—19.) I have seen both halves of the animalcule, separated during whole days, and two bladders, perfectly transparent and colourless, unloading in one another, and developing themselves. The bladders, where the contact took place, were visibly perforated. Soon after the developement of these bladders, I have seen the mass of the dark molecules of the bladder (d.) evacuated into the transparent one, in consequence of which a double stream of molecules (fig. 19. a. and b.) took place, crossing itself in the common opening, so that the molecules of the one ran into the bladder of the other animalcule, or part of it.

The *Cosmarium bipes* (fig. 20.) offers another instance of this exchange of a molecular fluid. We see here several animalcules under the form of a chain, united by obtuse points. Soon after this union, two other united animalcules open themselves by a long fissure (f.), and we see two streams of free molecules (fig. 20. a. g.) moving in the direction indicated by arrows, and operating in this manner the exchange of fluids.

The *Closterium acuminatum* presents an other instance of this exchange. In all the *Closteria,* seen sidewise, and where the two half cuirasses join, we discover two holes (fig. 57. 67. d. d. fig. 59. d. d. fig. 61. c.) opposite one another. The destination of these two openings was long for me a matter of doubt, till I could at last distinguish the junction of the *Closterium acuminatum,* in which two animalcules (fig. 59.) placed themselves obliquely one against the other, and till I saw, through these openings, the exchange of a transparent and scarcely perceptible fluid. In this union, we see also upon the cuirass an opening, both on the clear and on the convex side. This opening, however, is only visible during the union, described (fig. 59. x.). At all other times, in spite of all sorts of trials, I never could distinguish any thing.

The genus *Echinella* Ehrenb. (fig. 54 — 55.), beside the orifice (fig. 55. a.), has upon each cutting surface of its body, three lateral pores, consequently sex in all (fig. 54. 55. b. b. b.), passing through the cuirass. Though closely adhering together by these small cutting surfaces, I never could discover any exchange of fluids operated by these pores.

The propagation of the *Oscillatoriae* and *Diatomeae* is probably performed by decomposition of the parts; I never saw, however, propagation take place by division, admitted and even described by several naturalists, such as it may be seen in *Infusoria* of a higher category, and such as it has been admirably

described by Mr. Ehrenberg. What has been hitherto called *division of individuals* was only animalcules, parts of a whole or of a chain of animals. I never saw new limbs growing upon one of the animalcules separated from the chain; I never saw any one turning double, and consequently propagating itself either by a longitudinal or transversal division, nor after such a separation, artificially or violently executed, protracting its life, and still less, maintaining it, recuperating its individuality, and producing new animalcules of its own species.

The *Oscillatoriae* dissolve themselves in the already deceased lower parts, but a new animalcule never arises out of the fragments separated from that part. After having cut the filaments of the *Oscillatoriae*, I saw the one to which a part of the head was joined, creep, grow and continue to live, whilst the lower part, which had been cut, formed no new head, died, discoloured and discomposed itself.

In a series of observations, continued during several months, the *Cosmarium stellinum* alone presented an exception. After both animal bodies, half of which is represented (fig. 22. A.), are separated, a new sprout (fig. 22. B.) issues from the axe of each body. This sprout, at first round, exhibits later the first or principal incisions of its body, and afterwards those of the second and third rank. All the points and cuts are still obtuse and rounded; among the 52 points coming on each side of the body, 19 only are developed, which, divided later by new

incisions, grow angulous, sharp and pointed. When the young animalcule has attained the size and form of the maternal part, the union continues still some time, and is soon separated, whilst the female animalcule advances towards death and dissolution, to repeat the above described process, and propagate in this manner its genus and species.

After having described the propagation of these animalcules, such as we have observed it, we shall venture to say a few words upon the question of *aequivocal generation,* which has been in our days a subject of so much controversy.

Reason speaks in its favour; I might almost say, acknowledges it, but the most direct and impartial observations seem to be in contradiction with it.

The water I put in contact with pure organic matter, with full certainty that no egg nor animalcule could have been mixed to them, and abandoned to putrefaction, has generated nothing, during 4 — 8 months, except *polygastric Infusoria,* some species of *Monas* and *Colpoda,* small *Vorticellae,* and very seldom a little *Vibrio* (*Anguillula* Ehrenb.).

The *Naviculae,* the *Frustuliae,* and in general the animalcules belonging to this series, object of the present observations, have never appeared but in cases where I could prove their external origin. I never found these animalcules (except the *Oscillatoriae* often generated in infusions) but in river or marsh waters, as well as all the more developed

Infusoria and rotatory animals. Their propagation can be observed and obtained *ad libitum* in a room.

The equivocal generation has only reason in its favour and a very limited sphere of observations, owing to the excessive difficulty of observing such infinitely small creatures.

Propagation by sexual generation and by the formation of offsprings, has in its favour the greater mass of observations: which observations are positive in this case, and seconded by the form, appearance and size of these beings. The necessary conditions to these two modes of generation can be expressed by the following formule:

GENERATIO AEQUIVOCA.
SPONTANEOUS GENERATION.

ELEMENTS:	ACT:	PRODUCT:
— fluid substance, + solid substance, (— +) heat.	putrefaction, fermentation.	living being, *heterogenous* to the substances employed to its generation.

GENERATIO SECUNDARIA.
SEXUAL GENERATION.

ELEMENTS:	ACT:	PRODUCT:
— male organ, + female organ, (— +) life.	receptivity and reception.	living being, *homogenous* to those employed to its generation.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Surirella Venus,* weakly magnified. Natural length of the cuirass: 0,002565. Breadth: 0,000104 of an inch (Paris).

„ 2. Seen from above, more magnified.

„ 3. Open animalcule.

„ 4. Another, equally open; a. the cuirass; b. its inge; c. the white and transparent coat; d. incision, in the internal membrane; e. the brown or green content.

„ 4. A. Ribs and furrows B. on the edge of the cuirass.

„ 5. *Navicula ciliata,* two united animalcules. Length of the cuirass: 0,00044.

„ 6. Separated animalcule, sidewise seen.

„ 7. The same, seen from backwards; a. cuirass with angles and hairs; b. edge of the pedal surface; c. extremities of the sides; d. d. orifices of the alimentary tubes.

„ 8. The same animalcule, seen from the pedal surface; e. d. d. orifices of the two alimentary tubes seen sidewise.

„ 9. *Navicula costata,* seen sidewise; length: 0,00226.

„ 10. The same, seen from downwards; a. cuirass; b. the brown content; b^1 b^1, pedal bladders; f. f. intestinal tubes, and their orifices; d. ombilic of the middle ribs.

„ 11. Two united animalcules.

„ 12. *Frustulia appendiculata;* two united animalcules. Length: 0,00139; breadth: 0,00055.

Fig. 13. The same animalcule, seen from downwards; a. cuirass; b. pedal surface; c. c. brown content.

„ 14. *Frustulia agrestis;* two united animalcules. Length of an animalcule: 0,00054.

„ 14. b. The same e. f. standing and distant; c. d. the tubes uniting them.

„ 15. An animalcule, seen from the pedal surface; c. d. the openings in which the tubes (fig. 14. c. d,) draw themselves back.

„ 15. b. The same animalcule, seen sidewise; g. h. openings in the cuirass; c. d. openings of the tubes.

„ 16. *Pharyngoglossa sigmoïdea;* length of the animalcule: 0,002361. a. the stopple of the tube; b. the head; c. the foot of the anus; g. the anus; d. sexual warts. f. f. intestinal tube.

„ 16. a. Head of the animalcule, seen sidewise, strongly magnified; a. the stopple; b. the fissures of the cuirass with the foot; f. the intestinal tube.

„ 16. b. Head of the animalcule, seen from downwards; a. the stopple; b. the foot; d. sexual wart; i. brown content.

„ 16. c. Posterior extremity of the animalcule; c. the foot; g. anus; f. intestinal tube; i. content.

„ 16. D. Stopple a^2, drawn from the opening a^1 of the alimentary tube f., seen round the ligament b^1, to which it adheres.

„ 17. *Frustulia viridescens*, seen sidewise; a. a. pedal bladders. Length: 0,000185.

PLATE II.

„ 18. *Cosmarium deltoïdes.* d. rotatory molecular bladders in the middle; c. c. the same bladders on both sides; e. point of junction of the two animalcules; f. warty cuirass. Size of the double animalcule: 0,000278.

Fig. 19. The same animalcule, both halves separated; c. c. the lateral bladders; d. the middle ones with molecules; a. b. both bladders during the exchange of their molecular streams, in opposite direction.

„ 20. *Cosmarium bipes.* Two double animalcules, united at their extremities; b. b. the pedal bladders; c. opening of the mouth; d. the middle molecular bladders; e. e. the lateral bladders; a. opening or fissure of the cuirass, by which is operated the exchange of the molecular streams. f. g. size of the double animalcule: 0,00212.

„ 21. *Cosmarium sinuosum.* a. transparent edge of the cuirass; b. green content; c. middle rib; d. d. pedal bladders; e. opening of the mouth. Length of the double animalcule; 0,00075; breadth: 0,00031.

„ 22. *Cosmarium stellinum.* A. Maternal animalcule. B. The offspring Each adult half of the animalcule is provided with 52 points on the cuirass. Size of the double animalcule: 0,009545.

„ 23. *Cosmarium truncatum,* seen from the surface. Size of the double animalcule: from 0,003635 to 0,00400.

„ 24. The same seen from the angle.

„ 25. *Cosmarium Pelta.* c. brown content; d. the same already empty. Size 0,00043.

„ 26. *Cosmarium lagenarium.* a. a. darker substances in the green content; c. cuirass with a shagreen surface; b. side, joining both animalcules. Length: 0,00894; breadth: 0,00328.

„ 27. *Cosmarium Cucumis.* a. green content. Length 0,00221.

„ 28. *Colpopelta viridis.* a. mouth and alimentary tube; b. shagreen-like cuirass; c. green content. Length: 0,00344.

„ 29. *Micrasterias falcata.* a. oblique filament, joining both halves of the animalcule. Length of one part of the cuirass: 0,000165.

PLATE III.

Fig. 30. *Euastrum sexangulare.* a. middle cell, with six corners; b. edge-cells in two parts; c. transparent middle-skin; d. oily drops of the green content. Size: 0,000345.

„ 31. *Euastrum hexagonum.* Hexagon middle cells; d. transparent middle skin; a. thick oily drops. Size: 0,000915.

„ 32. *Euastrum pentangulare.* a. Middle cell with five angles; b. cells of the octogone forked edges; c. transparent intermedial skin; d. green and solid content. Size: 0,003195.

„ 33. *Stauridium bicuspidatum.* No middle-cell; a. intermedial transparent skin; green content, with small moveable oily drops. Size: 0,001765.

„ 34. *Stauridium Crux Melitensis.* a. Middle skin. The largest diameter: 0,00785.

„ 35. *Pediastrum quadrangulum.* d. Middle quadrangular cell, without intermedial skin, and consequently the intervals c. between the three empty and perforated cells; b. green content with molecules, and moveable oily drops. Size: 0,001765.

„ 36. *Pediastrum irregulare.* b. irregular middle-cells; a. a. cells of the forked edges with a green molecular mass. Size: 0,000960.

PLATE IV.

„ 37. *Sphaerozosma elegans.* Breadth of a member: 0,00095; a. globule uniting pairs of animalcules; b. b. these animalcules individually united by the intermedial membrane c. — d. d. oily drops with their content.

„ 38. *Diatoma fenestratum* Ag. Length of a member: 0,00103; breadth: 0,00042. a. brown content in the cells of members d. — b. seen sidewise; c. common intestinal tube of a chain of animalcules.

Fig. 39. *Fragilaria undulata.* Length: 0,00012; chain formed with three animalcules; a. a. two intestinal tubes; b. the foot; c. d. transversal tubes coming from each alimentary tube, so far as the edge c; e. cellular interval with a colored content.

„ 40. The same animalcule, seen sidewise.

„ 41. *Diatoma Navicula.* Length: 0,00104; breadth: 0,00025. a. orifices of a common alimentary tube; brown or green content of each cellular animalcule; b. a drop of oil.

„ 42. The same animalcule, seen from the surface of reunion.

„ 43. *Desmidium didymum.* Heigth of a member: 0,00055; breadth: 0,00199. Magnified chain of animalcules; a. intestinal tube; b. cuirass; c. flake uniting two animalcules.

„ 44. Animalcule seen from the uniting surface; a. tube; b. cuirass.

„ 45. *Syrinx annulatum.* Length: 0,00165; a. b. intestine tubes; c. cuirass; d. brown content; e. annular folds of the cuirass.

„ 46. The same animalcule, seen from the uniting surface. a. h. intestinal tube.

„ 47. *Paradesmus foliolum.* Chain of three animalcules; a. brown flake of the content; b. surface uniting two animalcules. Breadth of a member: 0,000255; length: 0,000540.

„ 48. *Scenedesmus ellipticus.* 0,0040. Four united animalcules, not distant.

„ 49. The same, distant; a. the animalcules; b. muscular flake of reunion.

„ 50. *Scenedesmus caudatus;* a. b. three animalcules near one another; d. the fourth distant; c. flake of reunion; e. pedal hairs. Length of a member: 0,00047.

„ 51. *Meridion cordatum.* Circular chain of animalcules; length of a member: 0,0095.

„ 52. Separated animalcule; b. brown content.

„ 53. *Scenedesmus pyrus:* 0,000355.

Fig. 54. *Echinella crenulata.* Length without feet: 0,000115.

„ 55. Two cells. a. mouth; b. b. lateral openings; c. c. square foot, common to both; d. d. brown content.

PLATE V.

„ 56. *Closterium Lunula* Nitzsch; strongly magnified; breadth: 0,00316; length: 0,01735.

„ 57. The same animalcule, still more magnified; a. mouth; b. rotatory bladder; c. intestinal tube; h. green content, with yellow oily drops; f. dented section; g. transversal band, transparent for want of the green content; d. d. the two lateral intermedial openings.

„ 58. Point of a horn of the cuirass, strongly magnified; a. mouth; b. intestinal tube; c. rotatory bladder; d. dark corpuscules of this bladder.

„ 59. *Closterium acuminatum.* Length: 0,00665. Perhaps the *Closterium Leibleinii* Kützing. (His drawing is too bad to ascertain it). Two united animalcules; a. the mouth; c. rotatory globules without bladder; e. intestinal tube and content; d. d. intermedial lateral holes; x. x. the same, by means of which both animalcules exchange their content; g. transveral bands.

„ 60. The whole animalcule of the same species.

„ 61. *Closterium costatum.* Thickness: 0,00147. A. A. Horns of the cuirass; b. b. mouth; a rotatory bladder; c. intermedial openings.

„ 62. Edge of the cuirass valve, in the point of reunion of the two horns; d. its sides.

„ 63. Point of the cuirass of the same animalcule; a. rotatory bladder; b. truncated extremity of the cuirass, as mouth; c. the rotatory globule in the bladder.

Fig. 64. *Closterium didymotocum.* Length: 0,00928. a. mouth; b. rotatory bladder; c. twin globules of the bladder; e. intestinal tube; f. large oily drops surrounding the tube; h. green content; g. union of both parts of the cuirass.

„ 65. Extremity of the cuirass, strongly magnified; a. mouth; d. rotatory bladder; e. twin globules; b. direction of their movement.

„ 66. *Closterium caudatum*, strongly magnified.

„ 67. *Closterium spirale*, strongly magnified; b. rotatory globule; d. middle opening; h. intestinal spiral tube (?)

„ 68. *Pleurosicyos myriopodus.* Length: 0,000624. a. sides (8); b. pedal bladders; c. transparent and transversal band.

„ 69. Animalcule seen from upwards.

„ 70. *Scalptrum striatum.* Length: from 0,00085 to 0,00096; a. pedal bladders (?); b. middle opening, by which the brown content is emitted; longitudinal stripes between both sides c. of the cuirass.

PLATE VI.

„ 71. *Oscillatoria subulata.* Thickness of the filament: from 0,00039 to 0,000465, strongly magnified; a. maternal filament; b. second filament; c. third filament; d. internodes; e. points.

„ 72. The same; a. Maternal tube; the content forms a small head b., pushed forward for the object of creeping.

„ 73. 74. *Oscillatoria elegans.* a. the head, moving in the direction of the arrow, like a pendulum; b. tube of the filament; c. blue greenish content, thickness of the filament: 0,000145.

„ 75. *Oscillatoria amphibia.* Strongly magnified; a. the head; b. division of a filament into two parts; thickness of it: 0,00046; heigth of the members: 0,00014.

Fig. 76. *Oscillatoria labyrinthiformis.* Br.: 0,00081; c. tube; b. green content with a square cavity a; d. division of the content in the tube.

„ 77. *Oscillatoria Okenii.* a. the head; b. the tube; c. the content; d. the cavity found within it; thickness of the filament: 0,000325.

„ 78. *Oscillatoria interrupta.* a. the head; b. the sheath; c. the content of a gall-colour; thickness: from 0,000045 to 0,00006.

„ 79. *Oscillatoria laminosa.* a. the head; b. the sheath; c. the content; d. empty interval; thickness of the filament: 0,000265.

„ 80. *Oscillatoria vivida.* Thickness: from 0,00010 to 0,0008. a. content with small oily drops; tube.

„ 81. *Oscillatoria punctata.* The green content, with black spots; lives amongst the precedent ones; thickness: 0,000015.

„ 82. *Melotomus Fragilaria.* a. member of the cuirass; b. brown content; breadth of a member: 0,00033.

„ 83. *Ophiothrix sphaerocephalus.* a. surrounding the *Oscillatoria interrupta*; b. the head; c. the neck; thickness of the filament: 0,0017.

„ 84. The same, more magnified; d. tube; d. green content.

„ 85. *Sphaerodesmus bicolor.* Thickness of members: 0,000251; a. green globular members; b. orange-coloured internodes.

„ 86. 87. *Sphaerodesmus depressus.* Breadth of a member: 0,00018. a. transparent intermedial bladder; c. double members; b. transparent internodes.

„ 88. 88. *Sphaerodesmus spirillum.* Thickness: 0,000281. Fig. 89, natural thickness; fig. 88. rolled filament.

„ 90. Middle cell a. and filamentous members b. of the same animalcule.

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THIS Flora, if we merely speak of the town, is a Flora of the forests of inferior regions; but, if we include the Metalliferous Mountains *(Erzgebirge)* and their highest points so far as Gottesgab, this forest region extends from one of its limits to the other.

Although some plants of the plains of Bohemia are found about Carlsbad, they do not properly belong to its Flora, and it is only near Lipkowitz, twenty english miles from Carlsbad, towards the interior of Bohemia, that we find, in great quantity, the species and individuals common to plains.

This Flora distinguishes itself principally by plants peculiar to the forests of the middle and North of Germany, and even by those which are found in the northern parts of that country, and still more by

those which belong to the North of Europe. The country, with the mountains near Marienbad, and those of the environs of Ellbogen, even in its greatest extent, as far as the heigths of the *Erzgebirge*, presents formations of primitive rocks, destitute of that multitude of plants growing in Bohemia upon calcareous and basaltic mountains of the adjoining circles (counties) of the kingdom. Carlsbad has in its vicinity neither lakes nor marshes, asylums of an immense number of plants.

The country presents ridges of hills, between which are broader or narrower valleys, but, at a little distance from the town, we find two of these, viz. the one in which the Teple runs rapidly in a narrow bed, and the other, crossed by the Egra, flowing quietly in a wide bed, which grows narrower higher up near Ellbogen, and expands into a greater breadth, as it descend through fertile fields and blooming meadows. Upon the left bank of the Egra, we see round hills, which, getting gradually higher, begin the *Erzgebirge*, incircling agreable and well cultivated valleys.

These hills, seldom extending to mountains, are entirely or partly wooded, but these forests are mostly coniferous, but sometimes intermixed with leaf-trees. These valleys produce wheat, rye, barley and oats as well as vegetables. Flax, potatoes, thrive also in the higher parts. The raw climate of Carlsbad is unfavourable to fruit, and the best is brought from the warmer circles of Saaz and Leitmeritz.

It is truly astonishing that, in spite of the enormous quantity of salt, which (according to approximative calculations) the waters of Carlsbad pour into the Teple, viz. ℥. 786,884 of carbonate of soda, and ℥. 1,132,923 of sulfate of soda, we do not find in their vicinity any saline plants, except the *Spergularia marina,* whilst near Franzensbad and several wells of bitter waters, near Seydschitz, we meet with saline and sea-shore plants.

The numerous turfy grounds about Carlsbad offer many rare plants.

In the following List, the Genera are ranged according to the natural method. In order to give a more complete idea of the vegetation of the country, we have not only included the plants peculiar to forests, but the rarer ones, which this Flora offers, though foreign to them. The knowledge of the cellular or cryptogamic plants found about Carlsbad (mosses, hepatics, lichens and algs) being hitherto very imperfect, we must differ their enumeration to another opportunity.

Thalictrum aquilegifolium.
Ranunculus nemorosus.
Aconitum Camarum.
Actaea spicata.
Dentaria bulbifera.
Cardamine pratensis multiplex.
Arabis Halleri.
Teesdalia Iberis.

Thlaspi alpestre.
Viola sylvestris.
— *Riviniana.*
— *mirabilis.*
Parnassia palustris.
Drosera rotundifolia.
— *longifolia.*
Polygala oxyptera.
— *Chamaebuxus.*
Dianthus superbus.
Silene viscosa.
Spergularia marina.
Geranium divaricatum.
Staphyllea pinnata.
Genista tinctoria.
Trifolium spadiceum.
Galega officinalis.
Orobus tuberosus.
— *albus.*
Lathyrus sylvestris.
— *latifolius.*
Vicia sylvatica.
— *cassubica.*
Spiraea Aruncus.
— *Ulmaria.*
Rosa pumila.
— *alpina.*
— *pyrenaica.*
— *tomentosa.*
Rubus plicatus.

Rubus fastigiatus.
— *cordifolius.*
— *hirtus.*
— *corylifolius.*
— *Weyhii.*
— *nitidus.*
— *dumetorum.*
— *Bellardi.*
— *saxatilis.*
Comarum palustre.
Potentilla alba.
Epilobium tetragonum.
— *montanum.*
Circaea alpina.
Sedum maximum.
— *Telephium (purpureum Auctor).*
— *villosum.*
Montia lamprosperma.
Ribes alpinum.
— *nigrum.*
Chrysosplenium oppositifolium.
Sanicula europaea.
Astrantia major, β. spinulosa: (involucri foliolis oblongo-lanceolatis apice serraturas 1—3 spinosas gerentibus umbellam paulo excedentibus).
Selinum palustre.
Angelica sylvestris.
Libanotis vulgaris.

*

Pimpinella magna.
Peucedanum cervaria.
Myrrhis odorata.
Lonicera nigra.
Sambucus racemosa.
Asperula odorata.
Galium sylvaticum.
— *rotundifolium.*
— *boreale.*
Valeriana officinalis, . *exaltata.*
Scabiosa sylvatica.
Cnicus heterophyllus.
— *eriophorus.*
— *acaulis.*
Centaurea nigrescens.
Gnaphalium sylvaticum.
Tussilago alba.
Inula salicina.
Artemisia scoparia.
Arnica montana.
Hieracium collinum.
— *sylvaticum.*
— *Schmidtii.*
Prenanthes purpurea.
Sonchus alpinus.
Phyteuma spicatum.
— *nigrum.*
Vaccinium Oxycoccos.
Erica carnea.
— *vulgaris*, β. *hirsuta.*

Pyrola rotundifolia.
— *minor.*
— *media.*
— *chlorantha.*
— *uniflora.*
Thesium alpinum.
Plantago atrata.
Lysimachia thyrsiflora.
— *nemorum.*
Menyanthes trifoliata.
Swertia perennis.
Gentiana cruciata.
— *ciliata.*
— *Amarella.*
Veronica montana.
— *longifolia.*
— *serpyllifolia, β. neglecta.*
Pinguicula vulgaris.
Euphrasia Rostkowiana.
Scrophularia vernalis.
Digitalis ochroleuca.
Verbascum Lychnitis, β. album.
Atropa Belladonna
Myosotis strigulosa.
— *sylvatica.*
— *spassiflora.*
Pulmonaria officinalis.
Melittis Melissophyllum.
Lamium rugosum.
Betonica stricta.

Rumex scutatus.
Polygonum Bistorta.
Alnus incana.
Betula carpatica.
— *nana.*
Salix grandifolia.
— *sphacelata.*
— *praecox.*
— *splendens.*
Allium ursinum.
Ornithogallum umbellatum,
β. refractum.
— *nutans.*
Lilium Martagon.
Leucojum vernum.
Orchis coriophora.
— *latifolia, cum varietatib.*
— *sambucina.*
Corallorhiza innata.
Gymnadenia albida.
Neottia nidus avis.
Listera cordata.
— *ovata.*
Polygonatum verticillatum.
— *multiflorum.*
Scheuchzeria palustris.
Juncus squarrosus.
Luzula maxima.
Carex pulicaris.
— *digitata.*

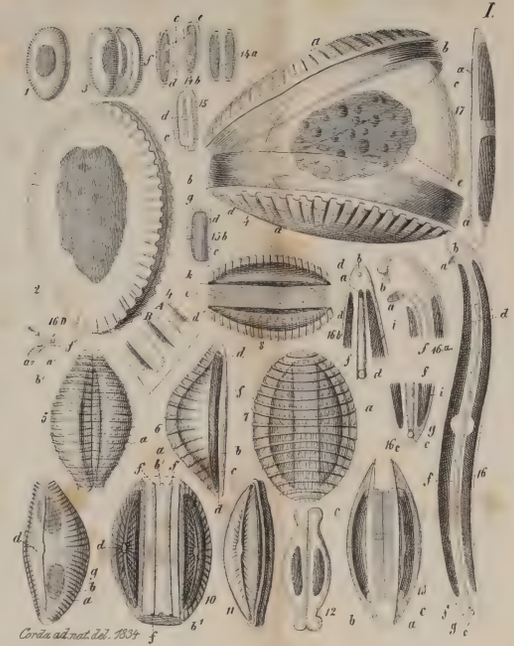
Carex cyperoïdes.
— *Drymeia.*
Eriophorum caespitosum.
Poa sudetica.
Triodia decumbens.
Bromus asper.
— *giganteus.*
Molinia caerulea.
Arundo sylvatica.
Elymus europaeus.
Equisetum sylvaticum.
Lycopodium clavatum.
Botrychium rutaceum.
Woodsia hyperborea.
— *ilvensis.*
Asplenium Adiantum-nigrum.
Aspidium Oreopteris.
— *Thelipteris.*

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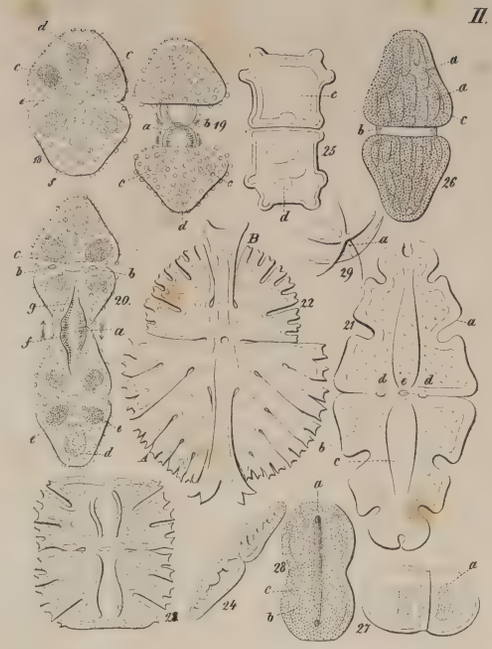
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I.



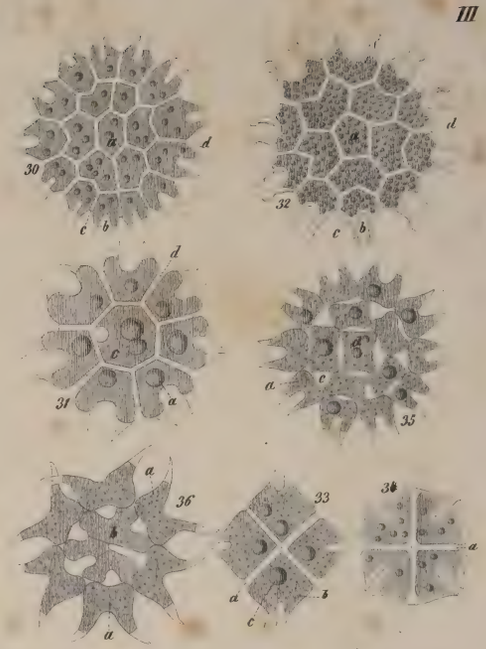
Naviculées. Naviculeae.

II.



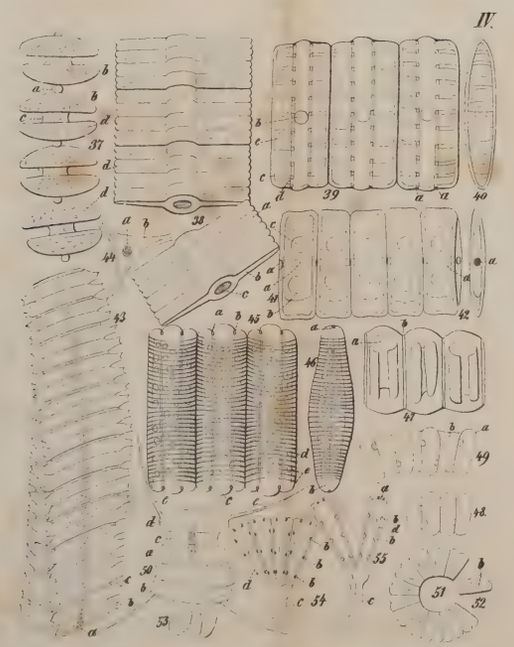
Kosmariées. Kosmariae.

III



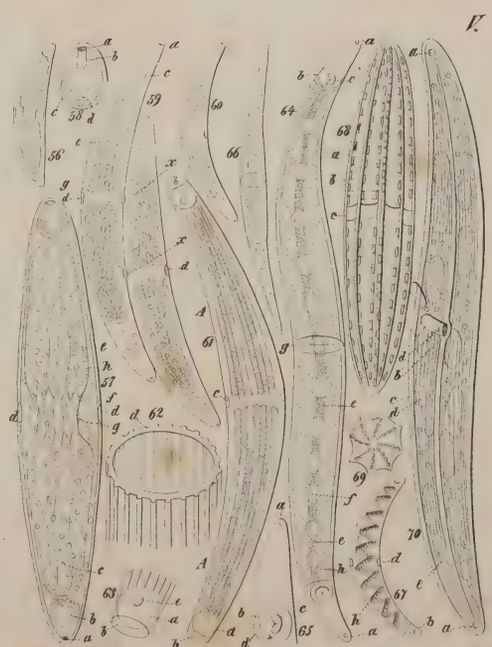
Euastrées. Euastrae.

IV.



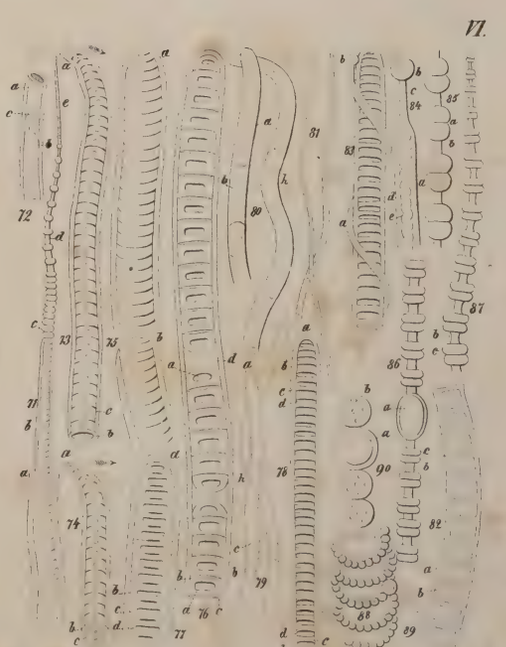
Fragilariées. Fragilariae.

V.



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Arthrodiées. Arthrodieae.

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